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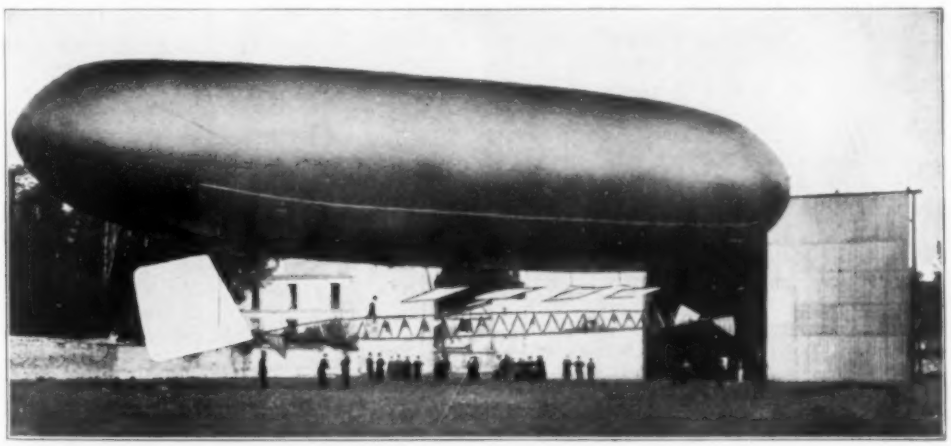
The Truth About The Flying-Machine

Difficulties to be Overcome--Limitations of the Air-Ship--Practical Navigation of the Air Not Yet Solved

By C. H. Claudy

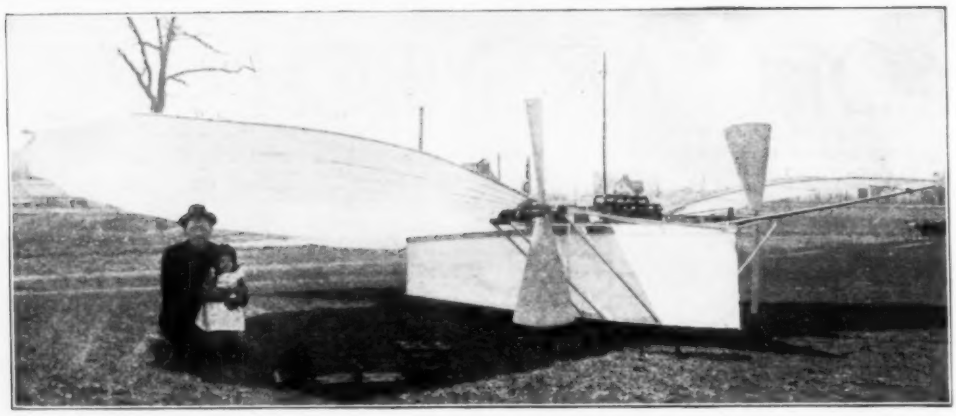
The announcement of a prize of $100,000 by the St. Louis Exposition, to be awarded the most successful air-ship or flying-machine exhibited, has caused an unprecedented interest in the greatest of all unsolved problems of transportation. Hundreds of inventors have been and are at work on models of various devices, many of them men who know absolutely nothing of physics, aerostatics or meteorology and who are, therefore, doomed, in advance, to ignominious failure. Every now and then some one succeeds in getting up in the air a balloon and propelling it, with more or less success, against the wind by means of a gasoline engine or other power source, and the claim is then heralded forth, from one end of the world to the other, that the problem has been solved.



Santos Dumont's Air-Ship No. 10

This problem, however, is entirely different from the popular understanding of it. Air-ships and flying-machines are, to many, synonymous terms, while, as a matter of fact, they are as widely different as sailing vessels and submarine boats. The air-ship, like the water-ship, is a structure sufficiently light to float in a supporting medium and provided with a means of propulsion, the only function of which is to move the fabric and not in any way to support it. Unlike the water vessel, however, the air-ship has only one medium in which to work, while the boat has two.

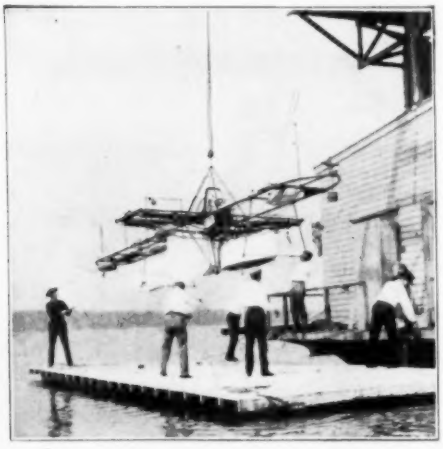
The flying-machine is a structure heavier than its supporting medium and is designed to support itself in the air by the exercise of power generated by apparatus contained in the machine. There is still a third and, perhaps, even a fourth type of aerial vessel, which has, as yet, no distinctive name. For example, a balloon having only sufficient gas to balance the weight of the fabric



Gustave Whitehead and His Flying-Machine—A Partial Success

against the attraction of gravitation and depending upon its own power for propulsion up into the air as well as propulsion forward and back. Such a machine might be termed a flying air-ship. The fourth class of aerial vessels would consist simply of a kite-like structure and is designed only for short and intermittent flights. Such structures are usually termed aeroplanes. This term is not distinctive, inasmuch as all flying-machines are provided with wing-like extensions which are called by the same name.

It is impossible, within reasonable limits of space, to attempt to describe the hundreds of individual attempts which inventors are fathering the world over. The enterprise must be looked at in a general way. The air-ship itself is now an assured success. Santos Dumont, Count Zeppelin, Doctor Greyth, Mr. Lee Stevens, the Lebaudy brothers, and a host of others, have successfully navigated the air in a mechanically propelled cigar-shaped balloon. Commercially, of course, the air-ship is not developed. It is, as yet, a most expensive and dangerous pleasure-craft and, in proportion to its size, can carry less weight and passengers than the smallest ocean-going craft. Whether or not it will ever become a commercial success depends almost entirely on the invention of a motor, the power of which will increase in a greater ratio than the weight. If it were possible, for instance, to construct an engine which would deliver one horsepower for every pound of engine, the public generally would be flying around now in the air as do the owners of automobiles upon the ground. Inventors who are wasting time and money on the construction of new shapes of balloons could very much better devote their time and energies to the simplification of the gasoline motor, or the discovery of some new means of generating force from an apparatus which would weigh but a few pounds to the horsepower.

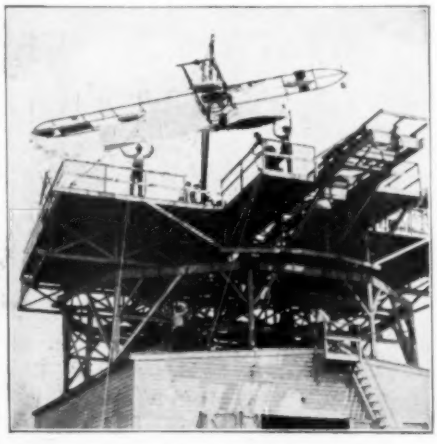


Hoisting the Langley Machine to the Launching Stage

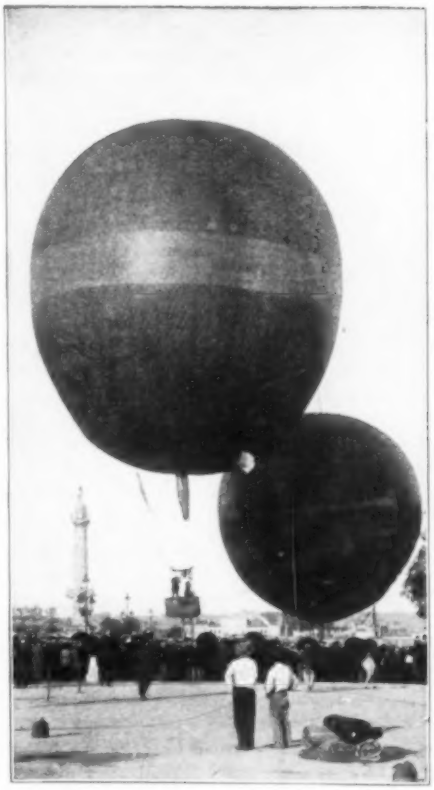
The flying-machine is the most misunderstood of the various factors connected with the problem of aerial navigation. The recent unsuccessful attempts of Prof. Langley, of the Smithsonian Institute, have, unfortunately, most unjustly been made a subject for many ridiculing remarks on the possibility of mechanical flight. Both Sir Hiram Maxim, in 1894, and Prof. Langley, in 1896, demonstrated, both in theory and practice, the possibilities of mechanical flight of a fabric heavier than air.

Prof. Langley has spent nearly twenty years in the investigation of the problem, using the most approved scientific methods to determine the almost hundreds of points necessary to understand before ever attempting to build a flying-machine. In 1896, after repeated unsuccessful trials, he succeeded in launching a model flying-machine over the Potomac river, which, twice in succession flew over one-half a mile. This model was propelled by steam, and its flight was circumscribed by the small amount of boiler-water it could carry. Since that time Prof. Langley has been working upon his larger air-ship, in which Mr. Manly, his assistant, twice attempted flight in October and November of 1903. That the attempts were both unsuccessful might have been due to a hundred causes. Inasmuch as it took Prof. Langley fifteen years to get his model in running order, it is by no means to be understood that because of one or two, or half a dozen, unsuccessful attempts with the larger structure, the machine or the principle is a failure.

Without going too much into the technicalities of the subject, a few words may here serve to explain the elements of the principles on which the aeroplane flying-machine of Prof. Langley is constructed. In the first place, it is a well-known law of physics that could sufficient speed be imparted to a projectile it would never fall to the ground, but would continue to circle the earth for an infinite period. Everyone knows that the harder a missile is thrown, the further it will go. The reason is very simple. Two similar bodies released from



Getting the Langley Machine over the Edge of the Launching Stage



Ballooning in Paris, A Popular Sport

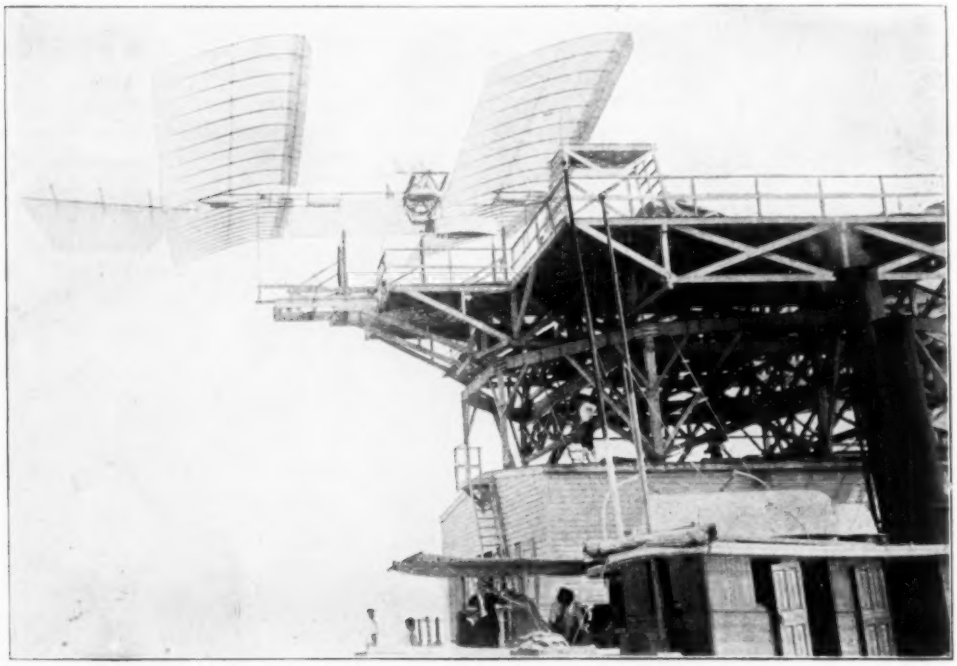
support at a given height will fall to the earth in the same time, regardless of whether one is moving forward and the other stationary. If a man stands on the top of a house and throws a stone with one hand and drops another stone with the other hand, the two stones will reach the earth at the same time, providing the stone which was thrown was projected from the hand in a horizontal direction. Another well-known fact which illustrates one of the principles of Prof. Langley's machine is that a skater can propel himself over very thin ice, providing he goes fast enough, when the same ice would not support his weight if he were stationary. One-half an inch of ice might support a weight of one hundred and fifty pounds for perhaps one-half a second. If, however, that one hundred and fifty pounds within that one-half second can be distributed over twenty feet of ice, the weight is as secure from breaking through as if it were stationary on a piece of ice ten inches in thickness. To return now to Prof. Langley's machine, it can be regarded

as a stone which is flung into the air, and which, by means of its propellers, keeps propelling itself with a force equal to the initial throw. The aeroplanes, wing-like structures, have a slight tilt from stern to bow, so that their action when rushing against the air is at once similar to that of a kite and to the skater who is distributing his weight over a large surface of ice. The flying-machine, which would not be supported by its wings for more than a fraction of a second if stationary, by distributing its weight over many columns of air within a second, succeeds in maintaining its place with only a slight drop. This slight drop is overcome by the upward tendency of the entire machine by the kite-like action, which, in turn, is caused by the slight upward tilt of the aeroplanes when drawn against the air.

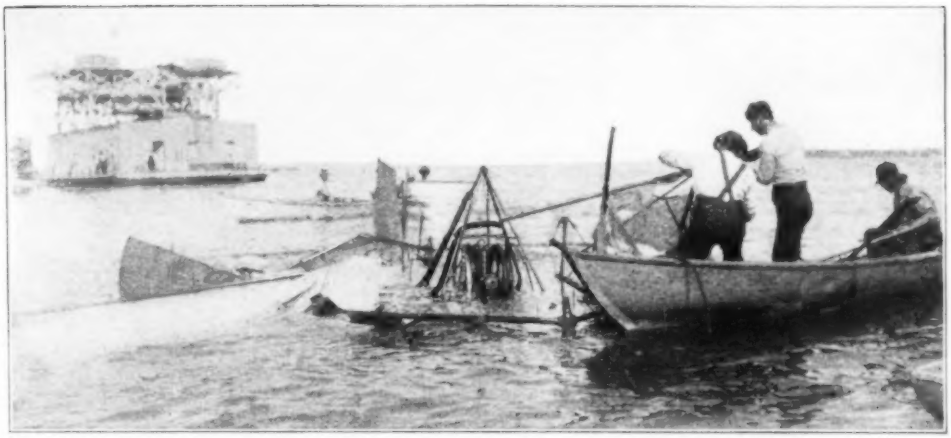
There is another factor which enters into the construction of such a machine as the one under discussion, which is known as Langley's Law. This law is to the effect that within certain limits, the faster the flying-machine is being propelled through the air, the less power is required to maintain the speed. It would be very difficult to demonstrate without recourse to mathematics of a puzzling and abstruse character the practical proof of this law. That it is accepted, with certain exceptions, by the scientific world is due to the exhaustive experiments made by Prof. Langley with his whirling table, a device for the study of captive aeroplanes.

Of course there are an immense number of little adjustments—balancing mechanisms, rudders, the proper places for the propellers, etc.—which enter largely into the practical side of the problem. Enough has been said, however, to show that the flying machines of Langley's model are not built or launched in a hap-hazard fashion, but are the result of practical discoveries at the end of patient research.

As has been stated before, the air-ship part of the problem of aerial navigation is now a practical, although not a commercial, success. The flying-machine part of the problem is still in the beginning of its most elementary experimental stage, but inasmuch as models heavier than air have successfully navigated that medium, it is obviously only a question of time, of money, of patience and of brains, before this part of the problem also becomes practically successful.



The Langley Machine Ready to Launch



Wreck of the Langley Machine, October, 1903

Whether or not any type of air-ship will result from present investigations, which will be able to carry trade or to safely transport passengers, is purely a matter of speculation.

PHOTOGRAPHED THE PEAKS OF THE ALPS FROM A BALLOON.

A most sensational balloon ascent was made by Captain Spelterini of Zurich recently when he tried to cross the Alps and the towering peak of the Jungfrau in his enormous balloon "Vega."

The ascent was made from a specially-built platform at a station on the railway which ascends the Jungfrau. The big balloon which holds 56,500 cubic feet of gas rose successfully and passed over the mountain summits towards Adelboden. It first crossed the Jungfrau mountain towards Valais, then became enveloped in clouds and was thrown back towards Adelboden again where a landing was made. The Jungfrau is 13,671 feet above sea level, and the balloon ascended to an altitude of 20,000 feet. The trip was made for the purpose of securing photographs of the Alps and, as the weather was fine for several hours, this object was successfully attained.

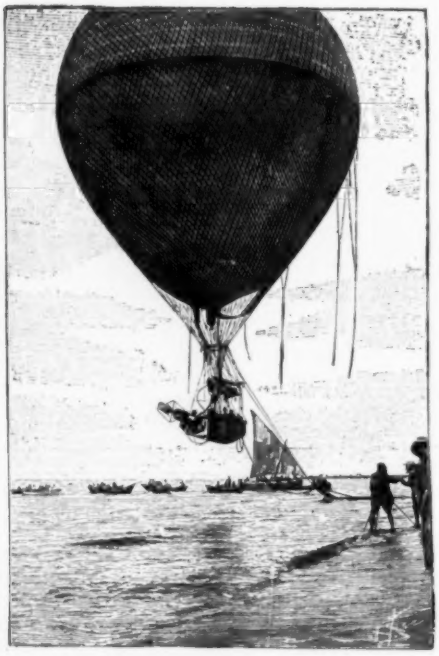
FRENCH AERIAL CRAFT HAS SOME STRANGE NEW FEATURES.

The "Mediterranean II." is the name of the immense balloon constructed by M. Herve, a Frenchman, who, for many years, has been experimenting with aerial craft. M. Herve began with the first principles of aerial navigation, proved them to his own satisfaction, examined, applied and reapplied them until today the Mediterranean II. represents the results of his years of study.

This balloon in point of equipment is most unique. It consists primarily of an enormous gas bag with dependent carriages for the aeronauts, but the amount of gearing and apparatus aside from these is astonishing. There are two wicker baskets, a very large one below and a smaller one above, and these are connected by strong taut rope ladders which lead on up to the gas bag so that at all times it may be reached by the occupants of the baskets.

One of the most unusual features of the balloon is its enormous aluminum propellers pitched at an angle determined after many severe tests and several disappointing failures. These propellers measure 23 feet from tip to tip, but only weigh 176 pounds, or, with the mast, transmission gearing and its brake, 232 pounds. They consist of two narrow blades placed one behind the other and joined in shutter fashion by small movable partitions. The propellers are geared to a powerful gas engine and, with the use of 18 horsepower, produce 397 pounds resistance at a fixed point. The propellers may be reversed.

But the feature of the greatest interest in the Mediterranean II. is the means by which, when passing above the sea, she is held steady and at any given height as she moves along. This is what is termed by M. Herve a pneumatic rudder and consists



The "Mediterranean II" Sailing Above the Sea

of a long drag of fabric connected with the gas bag of the balloon itself.

The balloon is an enormous affair. The pendent apparatus measures about 25 feet and this, surmounted by the huge gas bag 80 feet high, and trailing, either in the water or high in the air, the long snakelike drag, completes a conveyance unique in its line.

On the opposite page (1207) is shown the lower part of the "Mediterranean II" in the big shed where it is housed. A very good idea of the size of the big propellers can be had by comparing them with the height of the men standing on the ground.

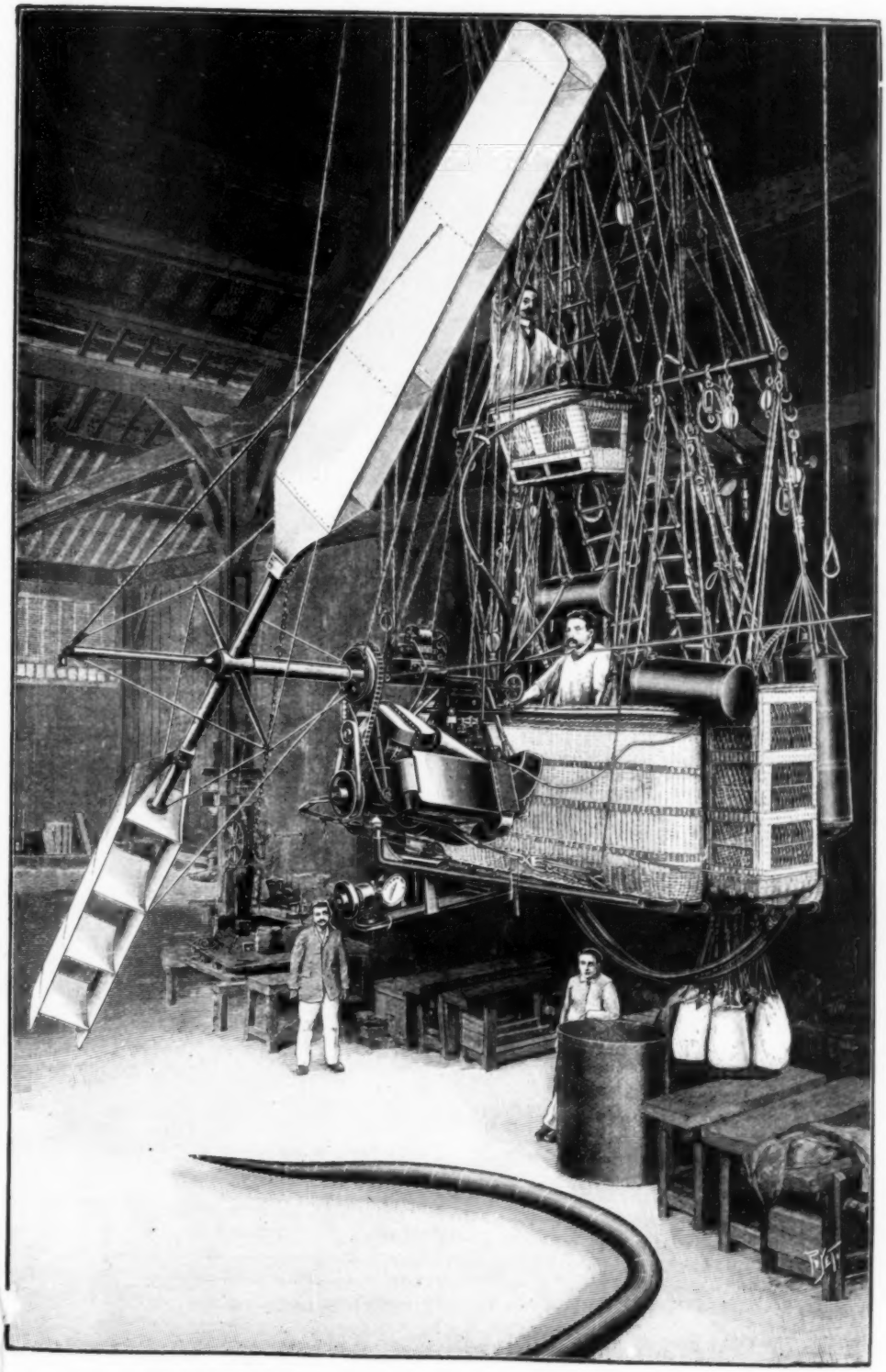
"I do not believe that, without such previous study and experience with a spherical balloon, a man can be capable of succeeding with an elongated dirigible balloon, whose handling is so much more delicate. Before attempting to direct an air-ship, it is necessary to have learned in an ordinary balloon the conditions of the atmospheric medium, to have become acquainted with the caprices of the wind, and to have gone thoroughly into the difficulties of the ballast problem from the triple point of view of starting, of equilibrium in the air, and of landing at the end of the trip."—Santos Dumont.

AIRSHIP CONTESTS AT ST. LOUIS.

The much heralded airship contests at the St. Louis World's Fair for a cash prize of $100,000 was unquestionably looked forward to by the public as the greatest feature of the Exposition. So much had been published during the past two years, and the accomplishments of Santos Dumont, in Paris, and the prospect of winning an independent fortune, combined to raise high hopes in the expectations of the people. If Dumont can sail an airship around the top of the Eiffel Tower, we naturally reasoned the Yankees were smart enough to cover the course prescribed by the Exposition officials. As a matter of fact, the required performance cannot be considered severe or unreasonable, for no air vehicle should expect to lay claim to being a practical success which could not earn the prize on the conditions imposed.

A great balloon house and park were constructed at a cost of many thousand dollars, and every facility provided for the expected contestants. In all parts of the country, local papers were telling about the wonderful airships which were ready, or almost completed, or to be built, and apparently the woods were full of inventors who had the prize as good as earned. But as the months went by less and less was heard, and it was only in the last fleeting weeks of the Fair that a few unsatisfactory attempts to fly a sky-chariot were made. The mystery surrounding the "accident" to Santos Dumont's craft, and his sudden return to Paris are still unexplained.

Baldwin's craft (described in October Popular Mechanics), the California Arrow, made several short, circling trips over and about the Fair Grounds, no one of which showed anything very remarkable. In its first trip it rose successfully under the direction of a Toledo aeronaut, A. Roy Knabenshuhe, and for a time answered its helm nicely, but before the test was over the motor broke, and though the aeronaut still guided the airship the result was anything but satisfactory, the ship being carried by the wind eastward. After drifting over the city, it crossed the Mississippi river and came down in a cornfield on the Illinois side. After another trip the airship broke loose while being carried back to the Grounds in the dark and was lost over night, some damage resulting. Its best flight was three and one-half miles, covered in twenty-eight minutes. In other flights it has traveled farther and stayed in the air longer, but the engine was not under control



The "Mediterranean II"—The Shed at Palavus.

all the time. After one flight the vessel landed within 100 feet of a designated point. Its highest speed made under control was but one-half the minimum speed fixed by the Exposition authorities in the rules governing the contests.

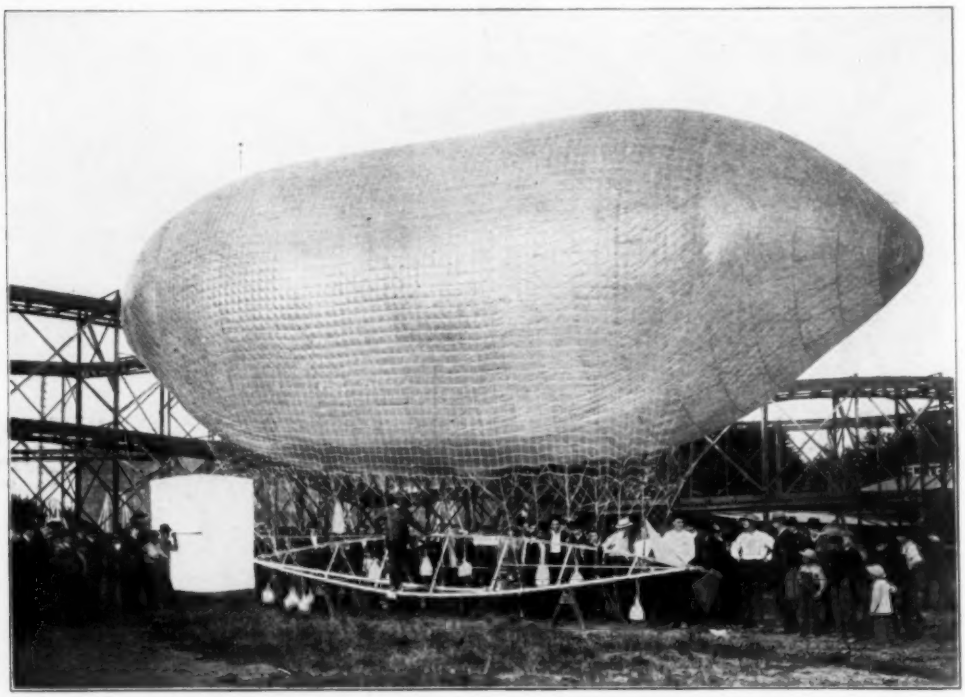
After several flights by the Baldwin airship it was announced that the great race would finally take place, and that several important entries had been made. Nothing further was heard about the contest by the outside world, however, and it now appears that after a rather spirited conference with the aeronautic officials Captain Baldwin has packed the "California Arrow" for shipment to California and has left the Fair Grounds himself.

Several ascensions of the old-fashioned gas balloons have been made from the Grounds, but were no different from what the public has been accustomed to see for years past, and the distance covered before the gas gave out was nothing unusual.

The airship races have proved a colossal fizzle, and while the public are disappointed, they cannot blame the management because the necessary contestants failed to materialize.

It is evident what we Americans don't know about navigating the air would constitute a large able-bodied fund of negative information. This should not be taken to be an admission that we cannot build and navigate airships, but simply that we have not done so. We can do anything inventors of any other country can do, and we ought to be able to accomplish a great deal more than they have, because their failures and experiences are ours, and our inventive ability should be better.

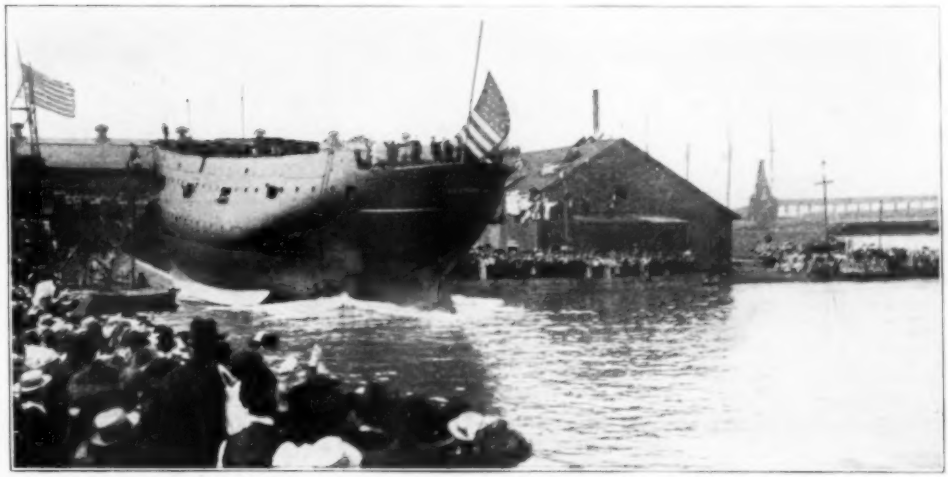
At present writing the situation of this country in the aerial world is simply that of being "not in it," and Santos-Dumont, a Brazilian resident of Paris, has us beat good and proper.



The Baldwin Air-Ship at the St. Louis Exposition

An airship race from Chicago to New York, or San Francisco to New Orleans, with a dozen entries, and at least half of them covering the entire distance without "going on shore," would be something worth while. But the St. Louis contest!—well, it's nothing of which to be proud.

The "Cumberland"—New Training Ship for American Jackies



Launching the "Cumberland" at the Boston Navy Yard

One of the new additions to the United States navy is the "Cumberland," recently launched at the government navy yards at Boston, Mass. This vessel, which is a steel sailing ship with a length over all of 210 feet 6 inches, draught of 16 feet 5 inches, and a displacement of 1,800 tons, will be used strictly as a training ship to teach young "jackies" how to sail a ship and shoot a gun. The only machinery on board are four engines for auxiliary purposes, such as hoisting, lighting and water condensing.

Accommodations have been provided for 16 commissioned and warrant officers and 320 enlisted men.

The battery consists of six 4-inch rapid-fire guns, four 6-pounders, two 1-pounders, and two Colt automatic guns, calibre 30. The cost will be about $370,000.

The "Overland" Mail in Thibet

How the Mail Bags of the British Mission to Thibet Are Carried Back to India

The bags are carried on rude ekka carts drawn by yaks. A British soldier is in command of the native attendants accompanying the carts.

Bridge Building in the Philippines

The construction of bridges in the Philippines is attended with a good many difficulties, not the least being that the tall trees of from three to five feet in diameter which are used nearly always have bees' nests in their tops and running when the trees fall does not save the men from stings.

Moreover, the engineers and native workmen must be attended by soldiers to protect them from attacks by Moro warriors.

The trees are felled with tiny axes and then there is neither saw mill or power plant to cut the timber; the work is done with hatchets and axes. The huge, tough roots of the trees are used for pinning the logs together, big bridges often being built without even an iron spike in the whole structure. The bridges are immense pyramids of heavy hardwood logs, with a rock filling for weight. Great timbers are laid across the supports and these are covered with a flooring of lumber. The bridge must be heavy to hold against swift currents.

Building a Bridge in the Philippines

ROAD LOCOMOTIVES

Road locomotive is the name which is now properly applied to the monster machines which are the outgrowth of the little traction engine of a few years ago. The size, weight and power of the road locomotive has increased with the rapidly increasing uses to which it is now applied.

The illustration on the front cover shows one of the latest types of road locomotives; a machine 25 feet in length, 10 feet wide and measuring 13 feet in height. The rear wheels are 96 inches diameter, 30-inch face; front wheels 54 inches, 14-inch face. The fire box is 58 by 39 by 45 inches; 93 boiler tubes, 2 inches diameter, 108 inches long; the grate area is 15 square feet, and the entire heating surface is 508 square feet. The boiler pressure is 160 pounds; engine speed, 200 revolutions per minute. The tender is of steel and will carry 520 gallons of water, sufficient for three hours, and 1,200 pounds of coal, which will run five hours on ordinary roads. The locomotive has a speed ranging from 2.64 miles to 5.69 miles per hour; the speed being regulated through gearing.

This machine is capable of drawing from 40 to 50 tons up grades from 5 to 10 per cent. The levers are all placed on one side for easy control from the engineer's seat.

When the good roads movement has secured really good roads throughout the country, the movement of farm produce in wagon trains drawn by road locomotives will be a common sight, and will enable the farmer to choose his line for shipment of freight without regard to his nearest railroad station.

POPULAR MECHANICS INDEX 1904.

A complete index to articles which have appeared in this magazine during 1904 is now ready and will be mailed free on request to all who desire to bind their volume.

BOUND VOLUMES OF POPULAR MECHANICS.

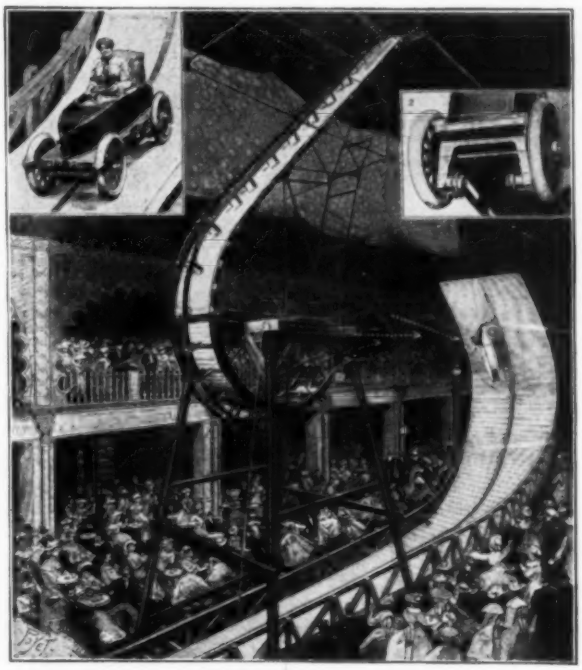
A limited number of bound volumes of Popular Mechanics, with index, for 1904 can be purchased of the publishers. The books are substantially bound with leather back. Price $3, express charges prepaid.

Meteor Auto, a French Amusement

A French pleasure resort has installed the most thrilling loop-the-loop device of any yet in operation. The apparatus is not so far open to the use of the public, which is continually demanding madder sensations, but, strangely enough, a woman, Madame Mauricia de Tiers, takes the seemingly perilous flight night after night, and the sight comes near affording sensation enough for even the most daring. The apparatus would, of course, perform the same wonderful feat without an occupant for the little carriage which makes the journey, but the insatiable public demands that a human being shall take the ride with all its risks, though the occupant in nowise controls the vehicle.

At the beginning of the daring feat Madame de Tiers seats herself in the little carriage, which weighs about 882 pounds and is shaped much like an ordinary automobile. It is 3 feet 3 inches wide and 5 feet 2 inches long. The under side of this vehicle is provided with rollers, as shown in the cut, which hold the car on the rails of the track on which it travels. The start is made on a 45-degree incline, which, at a height of 42½ feet above the ground, terminates in an arc of a circle, around which the vehicle dashes at a rate of nearly 40 miles an hour, and with a slight backward motion is carried by its momentum out across 33 feet of space, with wheels revolving, and is thus turned completely over and strikes a second incline, where the vehicle continues its course until terra firma is again reached. Fig. 1 shows the occupant on this second declivity as she always appears after the mad ride, smiling, serene, seemingly wholly unaffected by the perils through which she has just passed. The large view is from an instantaneous photograph made for La Nature.

The steering wheel on the auto does not guide the vehicle's movements, but is only for effect.

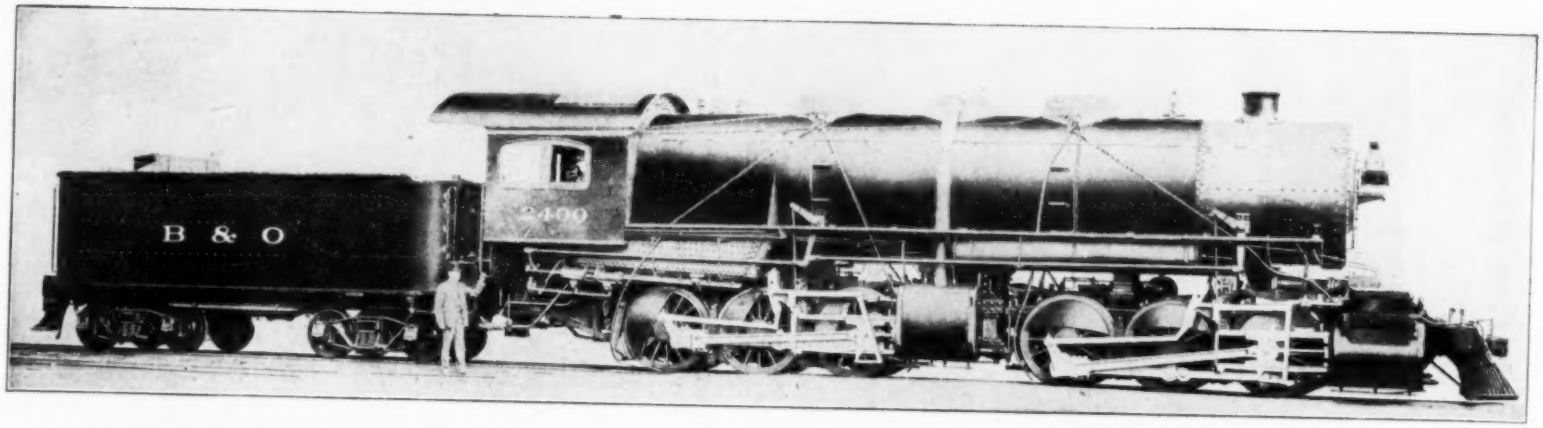


The Meteor Auto--A French Loop-the-Loop and Leap-the-Gap Device

PORTABLE FLOATING DOCK FOR BALTIC FLEET.

A floating workshop is considered indispensable to the operations of a modern battle fleet, but Admiral Rozhdestvensky has improved on this, and expects to be able to take a dock with the Baltic fleet out to the Far East. The admiral has given orders for a floating dock consisting of small sections to be built at Odessa with the utmost dispatch. There are to be eighty separate sections, which can be connected up so as to form a dock of different lifting capacities, with a depth over the keel blocks of from 26 feet to 27 feet. This would enable the dock to lift the cruisers of the squadron, although it would not admit some of the battleships which have mean draughts of from 26 feet to 29 feet. But as the dock is being built at Odessa, it is evidently intended to send it away by the cruiser detachment, which will go east by the Suez Canal.

Heaviest And Most Powerful Locomotive Ever Built



The heaviest and most powerful locomotive ever built has been on exhibit at the St. Louis World's Fair, and once again we describe "the largest locomotive in the world." It was constructed by the American Locomotive Company for the Baltimore and Ohio railroad and after the Fair will be used as a freight locomotive on that line.

The locomotive is of the Mallet articulated compound type, which is especially adapted for use on roads having heavy grades and sharp curves, as it permits compounding under the most advantageous conditions, as the high pressure cylinders can be applied to one truck and the low pressure cylinders to the other and any desired ratio can be adopted. The work is thus divided between the two sides of the engine and the retardation of cut-off gives a nearly uniform turning moment. The engine can be operated on curves of 20 degrees and upwards with great ease and less frictional resistance than an ordinary consolidation engine of half its capacity.

Each pair of cylinders is connected with three pairs of driving wheels, the rear high pressure group being rigidly attached to the boiler, while the forward or low pressure group is on a swiveling frame, the motion of which about its center is duly restrained by springs which also tend to bring the forward group of wheels into proper alignment when the engine enters a tangent. The wheel base of each group of three pairs of driving wheels is 10 feet, and total wheel base of the engine is 30 feet 8 inches. The total weight of the engine in working order is 334,500 pounds, or slightly over 10,900 pounds per running foot of wheel base. The normal tractive power when running compound is about 70,000 pounds, but this can be increased (by working the engine simple) to 85,000 pounds.

The outside diameter of the driving wheels is 56 inches. The boiler is of the straight top, radial stay type 84 inches in diameter at the front end with a working pressure of 235 pounds per square inch and a total heating surface of 5,585.7 square feet. The tender, which weighs 143,000 pounds, has capacity for 7,000 gallons of water and 13 tons of coal.

The engine measures 79 feet 6½ inches length over all; 10 feet 5 inches in width.

Sunken Treasure of Old Spanish Galleons to be Raised by Compressed Air

The sunken treasure ships of Spain are at last to yield their secrets and their treasure to the wondering eyes of men. For a period of 200 years they have rested under 90 feet of water on the bed of the Bay of Vigo, half buried by shifting clouds of sand poured upon them by two rivers which flow into the bay. The ships are supposed to contain $140,000,000 of treasure, but all efforts by divers to recover it hitherto have been fruitless because of the sand which prevented them seeing anything at that depth.

Cavaliere Pino, a Spaniard, as his name

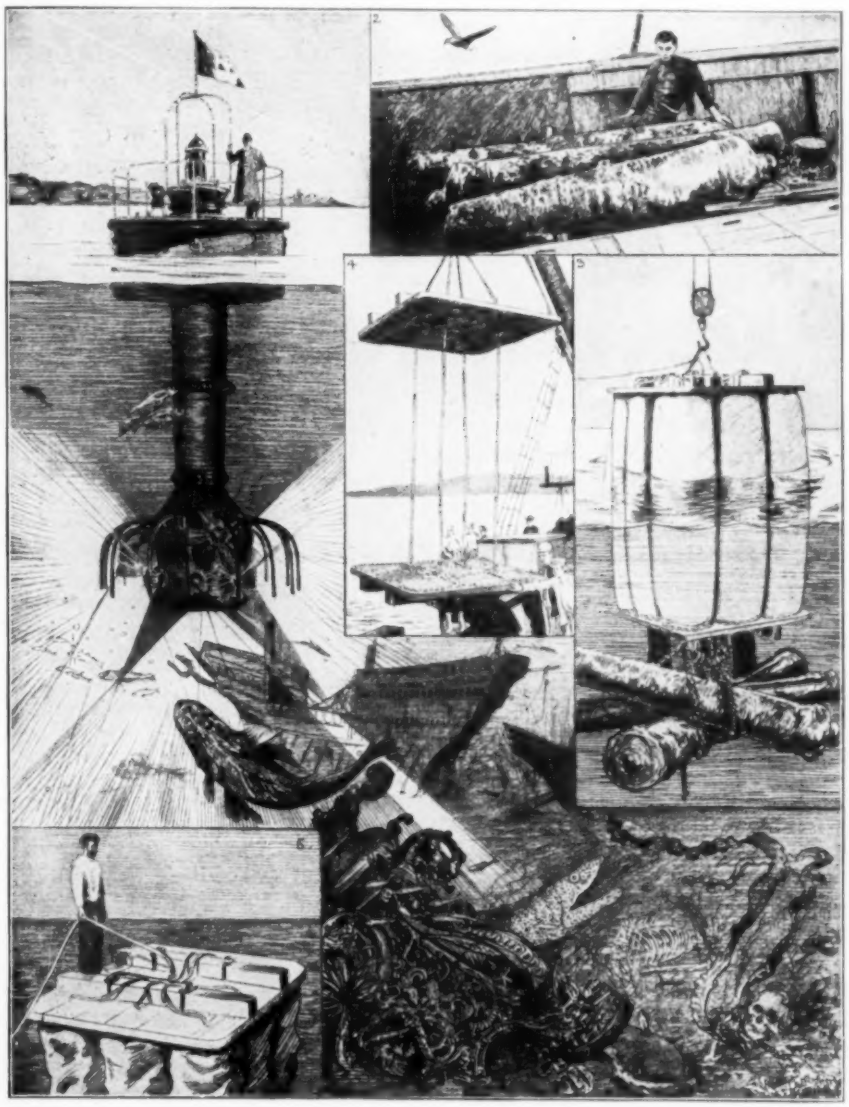


Fig. 1—Water Telescope.
Fig. 2—Guns Raised by Apparatus.
Fig. 3—Compressed Air Elevator.
Fig. 4—Framework of Elevator.
Fig. 5—Inflating the Bags.

indicates, has invented an apparatus by which the recovering of the sunken treasure is now assured. It consists of a water-telescope, the like of which was never before used for wreck-raising purposes. From a steel platform buoyed up by a mass of cork depends a strong steel tube large enough for a man to descend its full length on the steps within. The bottom of the tube is open and through it plays a strong current of compressed air to keep out the water. At the lower end of the tube is a huge camera having 12 powerful lenses which were specially constructed by Saint Goubin of Paris, and through which the man within the tube can view the wreckage to his heart's content and the tube can be slowly moved so that he can handle and examine any particular object (Fig. 1).

The tube, which is now in the course of construction, will be telescopic and capable of being elongated to meet the requirements of depth. It will be built in watertight compartments, lit by electric lamps and communication with the surface will be by telephone.

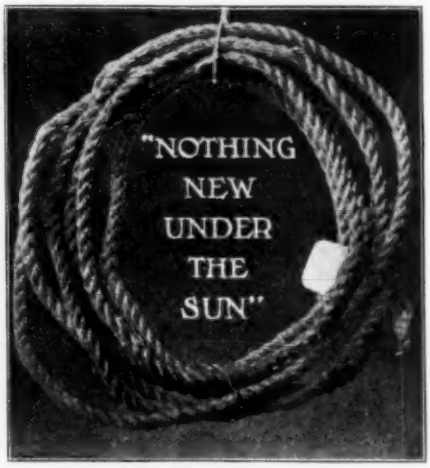
The Spaniard's method of raising wreckage is quite as unique and ingenious as his hydroscope. In Fig. 4 is shown the framework on which large flexible bags are arranged and connected to the special platforms of the framework. In operation this apparatus is attached to the object or objects to be raised and compressed air is pumped into the bags until the air pressure overcomes the resistance of the water and of the object and the compressed air elevator rises to the surface with its load, as in Fig. 3, where it is bringing up old guns. The guns so raised are shown at Fig. 2, and at Fig. 5 is shown the method of inflating the bags.

UNITED STATES BATTLESHIPS NOW UNDER CONSTRUCTION

The two battleships "Connecticut" and "Louisiana" recently launched, each of 16,000 tons displacement, will be among the most powerful battleships in the world. Besides these the government now has under construction eight large armored cruisers, two of 14,500 tons, three of 14,000 tons, and three of 13,600 tons and eight other battleships, three of 15,000 tons, two of 14,600 tons, two of 13,000 tons and one of 12,500 tons. If all these are in commission by 1908 we will have 24 battleships and 10 armored cruisers in our navy.

WIRE ROPE MADE BY THE ROMANS 1,800 YEARS AGO.

Nearly 2,000 years ago the Romans knew how to manufacture wire rope which closely resembled the wire rope in use at the present day. This astonishing fact was brought to light by the recent discovery of a coil of wire rope in the ruins of Pompeii. The rope is about 15 feet long and 1 inch in circumference. It is made of bronze wire



Coil of Wire Rope, 1,825 Years Old

and consists of three strands of spirally connected wire, each strand being made of 15 wires twisted together. A most interesting fact is that the rope is stranded in accordance with lang lay, which is in general use today.

It is believed that the rope was used as a crane rope, for pieces of cranes were found also. These cranes, it is generally believed, were worked by slaves who were placed inside a large drum, which was turned in a tread-mill fashion and thus worked the small drum around which the rope was found.

Pompeii was buried in A. D. 79, about 1,825 years ago. The coil of rope is now in the Musio Barbonico at Naples.

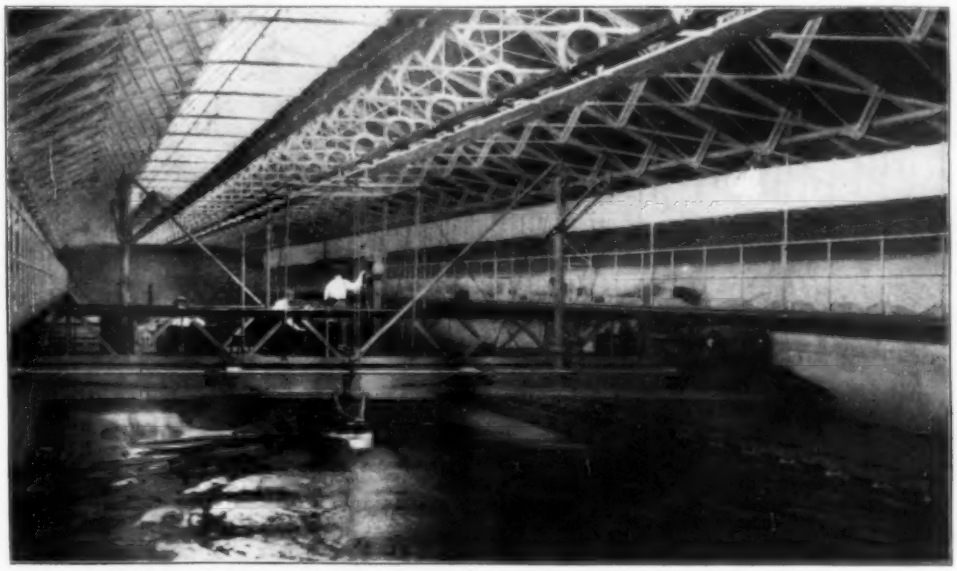
At an expense of $30,000 the Pullman Company will establish laundries, where at the end of a run all its employes may have their clothes cleaned at the expense of the company. Each of thousands of employes will be given three complete uniforms.

Forecasting Ship Speed and Action

How the Government Determines Precisely What a Great Battleship Will Do Before Even the Keel is Laid

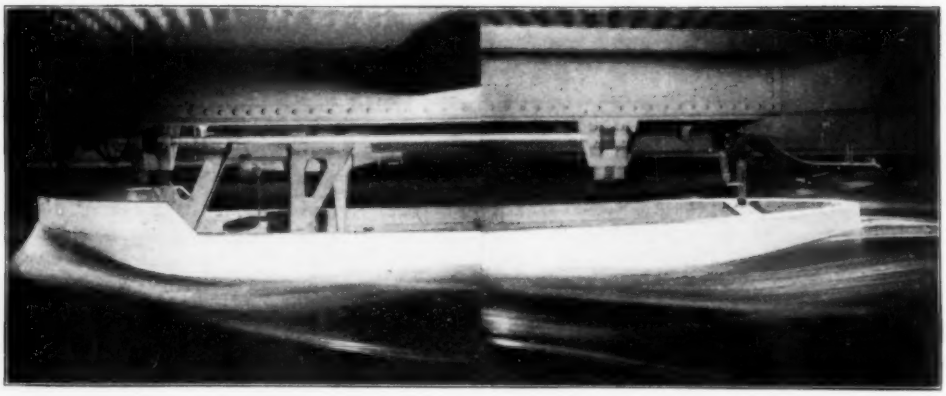
There is at the Washington Navy Yard a peculiar and interesting factory, the like of which is not found elsewhere in this country. It is a boat building factory, but the boats are not used for carrying people or things, nor are they toys. They are warships in miniature, the unequipped hulls, known as ship-models. When the government desires a new warship, and Congress makes the necessary appropriation for it, the Construction Department of the Navy makes the detailed plans in drawings giving every portion of the proposed vessel. This is done for two purposes—for furnishing working plans for contractors or government employed workmen, and for guides in making a model of the ship. The Department desires to know as far as possible what the speed and action of the designed ship will be at sea; and to find this a model of the vessel is constructed, run through the water of the testing tank and its actions noted. These trials may prove satisfactory at first tests, but if not so the model's lines are changed until better results are secured.

The model making factory is a large building situated near the model testing tank, close to the Potomac River, and contains a number of electric motors that do all the power work, except in one particular, the use of hydraulic pressure for putting together wooden blocks—"blocks of shape"—from which an initial model is made. These blocks are worked down to conform to the drawn ship plans, until an approximate hull-frame is obtained; over this, small half-round strips, making a corrugated appearance, are placed, and then plaster of Paris is put on and manipulated until the surface lines laid down in the plans are obtained.



Testing Tank With Model Going at Four Knots an Hour, or One-Fourth Ship Speed

After the bottom of the initial model is smoothed down it is taken to a reciprocating lathe, a machine about 40 feet long, operated by means of eight 5-horsepower



Side View of Model "Under Full Steam"

electric motors, and consisting principally of saws, planes and a guiding arm mounted on sliding carriages. While the first model is being made, a second, the real representation of the big ship, is in part constructed; thick strips of planking about three inches wide are glued together forming a rough shape of the true model needed. The initial model is now placed on the lower platform of the reciprocating machine and the true model placed above where it can be engaged by the shaping tools. When the machinery is set in motion the guiding arm, having at its end a concave metal block, follows the shape of the under model, and reciprocating saws cut to depths representing the latter's shape in the upper one. The model is now automatically planed down to the saw-cut shape, and is then worked over from measurements with hand tools until all the lines of the drawn plans are justified.

Now the embryo ship is painted, weighed, furnished with mechanical attachments and taken to the model testing tank to prove its fitness for the work desired. The tank is in a brick building 500 feet long by about 50 feet wide. On both sides of this there is a railed track, extending nearly the whole length of the structure, upon which runs a towing-carriage; this spans the tank and is operated by means of direct-connected motors, each of 50-horsepower, one being carried on each of the four carriage trucks. The power required is obtained from a separate electric plant in the Navy Yard, which also runs the model making shop.

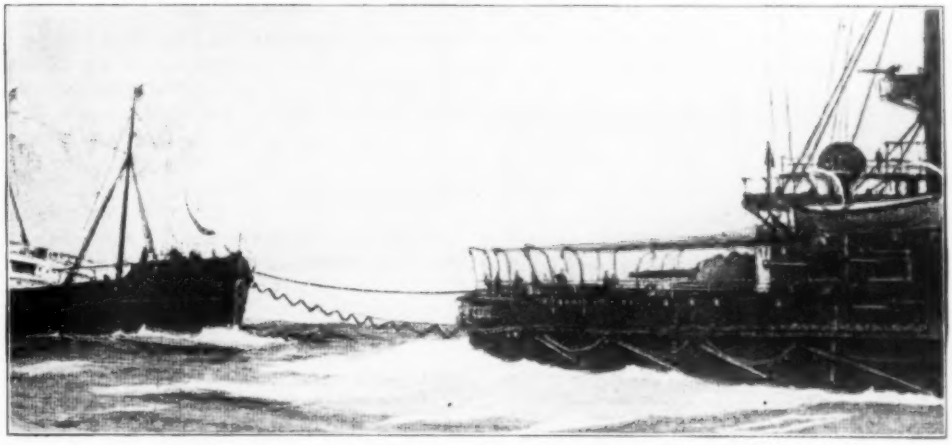
The model, usually about 20 feet in length, is put into the water directly beneath the towing carriage, to which it is movably attached by metal arms arranged at bow and stern. The model is also electrically connected with the carriage, which carries chronographic apparatus for measuring speed and force expended; also recording action of the miniature ship of war.

Models are tested at various speeds and these differ according to ship lines and amount of resistance against the water. The speed runs as high as six knots, corresponding to 27 knots for the ship at sea; but the average is about four knots, about one-fourth of the speed of the ship. The carriage runs very smoothly and can be speeded if necessary at the rate of 20 knots per hour.

The value of the information obtained by the Government from model testing more than offsets the considerable expense thus incurred. By this work the Navy Department not only secures an excellent idea of the capabilities of the proposed new ship, but it can use this data to advantage in making contracts with ship builders in the particular of required speed, etc. And with the builder there is no guess work; with the ship plans drawn to the smallest detail, and, if necessary, corrected from model tests, he follows instructions, and is carefully followed in his operations by the Government's expert who keeps track of every particular of the work.

The only woman "sword fisher" known, is Mrs. Jno. Latham, of Noank, Conn., where she and her husband reside during the winter months. She saved the life of her husband recently when attacked by a monster sword fish. The Lathams have a sloop which is used for sword fishing only.

Liquid Fuel Pumped to Battleship While in Motion



Pumping Oil to a Battleship While in Motion

The English navy has been experimenting with oiling battleships while they are still maintaining their maximum speed. The tests were very satisfactory, indeed.

The battleship took the oil vessel in tow with a 6½-inch wire hawser. From a lighter wire was suspended 200 yards of 6-inch wire hose fastened to the wire every six feet. The hose was fixed to the net shelf and then taken to the connection on the ship's side. The battleships "Hannibal" and "Mars," with which the experiment was tried, each carry 190 tons of liquid fuel, and this amount was pumped in six hours, the speed of the vessel being retarded but one knot. Another great advantage of this arrangement is that it can be used in any and all kinds of weather.

The German fleet is resorting to oil in increasing degree for firing purposes, it is stated. All German battleships burn both oil and coal, and several oil-tank vessels have been ordered constructed for the use of the fleet, as their use is said to greatly facilitate filling the war vessels' oil tanks, and to be more cleanly than coal bunkers.

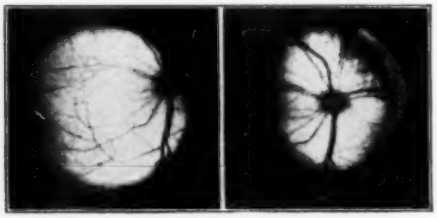
$10,000 FOR WINNER OF OCEAN RACE.

There is soon to be a race across the Atlantic between motor launches, and the winner (if he succeeds in getting across alive) will receive a prize of $10,000 which has been offered by M. Charley, a rich French sportsman. The contesting launches will be 65 feet or less in length and driven by gasoline engines. The Shipping World, London, says:

"M. Charley, in response to a wager from America, will himself compete with a 65-foot boat. It is interesting to note that Mr. Edge is experiencing in his 65-foot cruiser the same trouble as has been met in using turbines for naval propulsion. Like the turbine, the internal combustion engine must be driven at full power to work satisfactorily. The consequence is that Mr. Edge's boat will have three shafts and three engines. The two outside shafts will each be provided with a 150 horsepower engine, and the center one will be driven by a 40 horsepower oil engine. The idea is that only the small engine should be used for slow speeds or going alongside, whilst for full speed the two larger engines would be used, and for an extra fast burst all three would be in operation. It seems rather a tall order to start off across the Atlantic in a 65-foot motor boat; of course the boats which have entered are not the racing freaks which came across the Channel a short time ago; but I should at any rate like to feel sure that, in the event of the engine stopping, the boat could be kept going along with a mast and sail."

INSTRUMENT PHOTOGRAPHS THE INTERIOR OF THE HUMAN EYE.

Treatment of diseases of the human eye will be greatly facilitated by an instrument lately invented by Dr. Walther Thorner of the University Eye Clinic at the Royal



A Photograph Made With the New Instrument

Charité, in Berlin, by means of which good photographs may be secured of the interior of the human eye. Hitherto this had been impossible because of the difficulty in sufficiently illuminating the interior of the eye, the strong light and the duration of the exposure not being endurable by the patient. All observations of this part of the eye were made by looking at it through the ophthalmoscope, invented by Helmholtz in 1850.

The new instrument is a material improvement of the ophthalmoscope. It was first used in photographing the eyes of cats and then improved and reinforced until adapted to the much darker interior of the human eye. By employing a soft light the eye is first focussed so that its back is clearly imaged on a photographic plate. With the plate in, pressure on a special lever opens the camera and an electric spark generated in a storage battery ignites a flash-light composition, thus lighting up the background of the eye so that a good image is produced on the plate.

The new instrument means that diseases encroaching upon the eye may be watched in each stage, that the progress of the disease and the success or non-success of the treatment will be apparent at any and all times, and that physical differences in eyes will be plainly put before the oculist, who will thus be enabled to profit mankind by his observations. Any separate part of the interior of the eye may be photographed by the new apparatus.

Photographing the Background Of the Eye

AMERICAN-BUILT SUBMARINE BOATS FOR JAPAN.

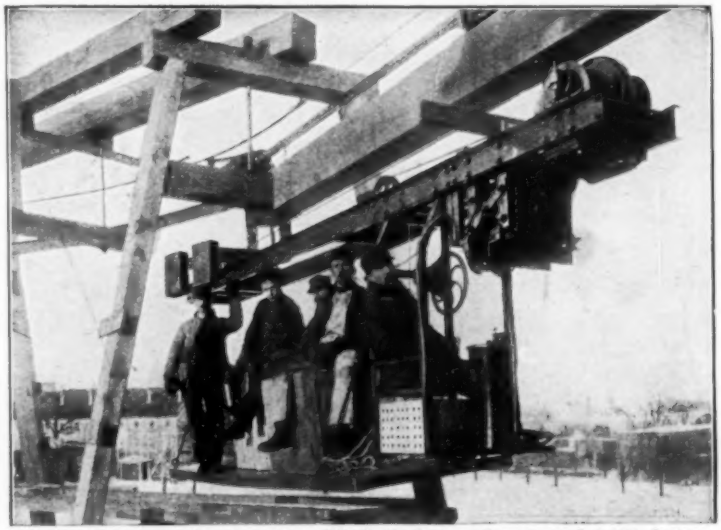
Five submarine boats, superior to those owned by any other nation, are now being built in this country for the government of Japan, though nominally, for the sake of neutrality, they are being built for the Holland Submarine Boat company.

The boats are 58 feet 9 inches from stem to stern, with an extreme width of 11 feet, and have a guaranteed speed of from eight to ten knots. They have a number of features which make them decidedly superior to any others of these craft now in existence. They are built of the best steel, reinforced amidships by 10-foot strips of Tobin bronze plates half an inch thick, making them far less vulnerable if sighted by the enemy when on the surface. They are equipped with bilge keels, which makes it possible for them to make long voyages and to accompany a fleet to sea without a tow. The "Moccasin" and the "Adder," the two finest submarine boats in the United States navy have a maximum speed of six knots: the new boats for Japan not only have a higher speed, but can maintain it at a depth of 120 feet. Few submarines formerly constructed often dive deeper than 40 feet. The greater speed involves a secret method of using both electricity and gasoline for motor powers, while diving rudders of secret design secure the greater powers of submersion.

Aerial Transportation

How the Telpherage System Economizes for the Manufacturer--Some Startling Facts and Figures

The word telpherage, which is derived from two Greek words meaning far and to carry, has assumed a meaning not included in those two words since it has become a great, though not widely recognized factor in industrial economics. No other word comes nearer being synonymous with economy than does the word telpherage. It means economy of time, economy of labor, economy of money. And yet, embracing all these advantages—considerations the American manufacturer is eternally striving for—this wonderfully effective electrical agent is little appreciated by those it is calculated to most benefit.



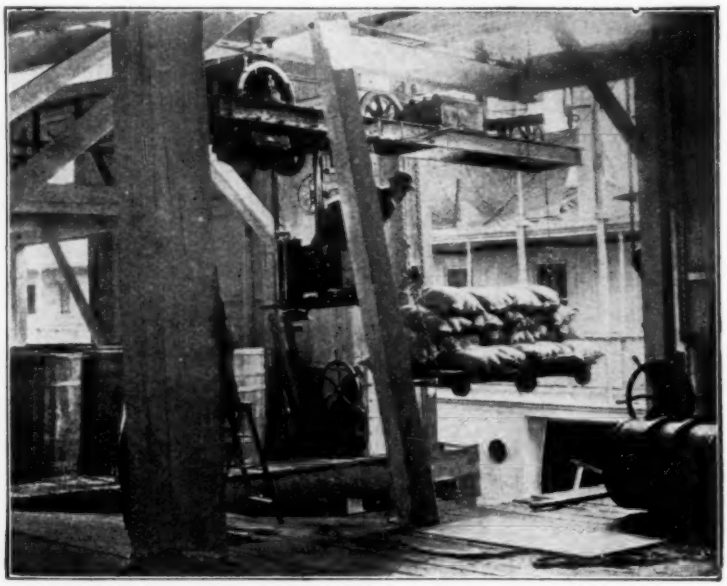
This load, with the five men, lifted 50 feet and conveyed 1,000 feet, showing massiveness of construction of the conveying and hoisting machinery, method of electrical control and brake wheel.

Perhaps the greatest claim that can be made for telpherage is that while yet embracing these three great economies, it is perfectly flexible, can be adapted to the most discouraging conditions without diminution of its efficiency. If the route of the telpher way is rough, and many obstructions have been encountered in its construction this does not affect traffic on the aerial line when once it is installed. With its use the bags, boxes, bales, or barrels which once consumed an amount of time, money and labor, disproportionate to the rapid operation of the rest of the modernly equipped factory, is reduced to its proper ratio and fits into the system as nicely as the cogs of one wheel engage those of another. Over a distance of 1,000 feet of telpher way, a single telpherman with one machine and an assistant can convey 250 tons per day and should the system be out of commission for even an hour, the plant during that time is a non-consumer except in interest charges.

Telpherage is best adapted to the action of the direct current as it is included in the "intermittent control" type of electric propulsion.

The telpher line consists of tracks of solid steel or steel cable built, usually, 20 feet or more above the ground. Where cables are used they are supported every 100 feet by means of poles or structures, if it is convenient to erect them, and with a solid track the supports are placed at from 16 to 20 feet apart. A telpherage plant usually consists of one or more telphers with or without trailers, but generally in combination with an electric hoist for lifting and depositing the load; a single or double trolley wire above the track for

conducting power to the telpher and hoist; one or more buckets or carriers for each telpher and the controlling switches, conveniently located. The material to be carried is suspended underneath the track and the carrier may be a large cage of any kind, or a truck with wheels for rolling it around on the floor. In long spans over river gullies, canals, railway tracks, etc., steel cable is invariably used instead of the steel track. When this is the case C-shaped wrought-iron hangers, having an upper



Taking freight from or lowering to the side ports of a steamboat. In unloading, the material is raised and then conveyed any reasonable distance. Load, 6,000 pounds; speed of hoisting, 60 feet; speed of travel, 1,000 feet per minute. Independent of fall of tide. Track can be extended so as to take load directly to or from barges or floats. In one telpherage installation one man replaces sixteen.

grasp on a stout suspension cable and a lower clutch on a 3-foot beveled shield into which the running cable is sunk, support the running cable between posts. This tightens the suspension cable so that excessive sagging of the running cable under a load is prevented and also maintains the latter at a slight elevation so that the track is level when the telpher crosses the shields.

This suspension is used in all cable installations and over rivers oft-times triple or quadruple suspensions are required and high structural steel towers at either shore provide the necessary suspension dip. The tracks inside buildings are solid steel, supported every 15 to 25 feet, and the trolley wire, which is above the tracks on the outside, is inclosed in a conduit to guard against fire and runs alongside the track on the inside.

The telpher is, in other terms, an electric locomotive of the very simplest construction. If the load is of such nature that all its weight is pendant from one point as in conveying coal, a follow wheel is attached to the telpher frame and for distributed loads a two-wheel trailer is attached by a connecting rod. The trailer is always used where a telpherman travels with the load.

The hoist is suspended below the telpher, or sometimes from a trailer drawn by the telpher. Special attention has been paid in the later designs of hoists to use as little headroom as possible. Formerly the telpher and hoist were combined, but experience has shown that it is better to make the telpher and hoist two separate pieces of apparatus. It is composed of a double gear, a worm and drum, and comes very near being a direct-connected appliance when in position on the telpher.

There are three types of telpherage—automatic, semi-automatic and non-automatic. In automatic control of telpherage it is possible for the operator to start the machine by means of its controller located at some fixed point and it will whizz along its track to the other end, automatically deposit its load, reverse its direction and return for another load. This is accomplished by the use of an electrically-operated switch working in conjunction with the controller. In ordinary e'ectric railway practice four wires are required in reversing each motor, but only two trolley wires are used in the entire operation described above. In the method of hoist operation each machine is supplied with a small cylinder switch which a solenoid, working against a spring, manipulates. In lifting a load power is infused through a stationary switch located at any point on the line, thus energizing the solenoid of the automatic switch and putting a tension on the spring. The solenoid is then de-energized, and the released spring rotates a cylinder which changes the various connections and so reverses the motor. The operator can cut off the power at any point in the hoisting and so stop the load, for all breaking of the current is done at the stationary controller and never at the cylinder switch on the hoist. The motor would be reversed by the cut-off, of course, but all that is necessary, should the operator wish the load to go higher, is simply to turn on the power again and again cut off, and when the power is again turned on the elevating is resumed. This method is also used in operating the telpher and in the control of semi-automatic telpherage.

The semi-automatic line may be controlled by a man in a small house on the trestle, who, when the bucket is filled, throws on his hoist switch, and when the load is at the height desired opens the telpher switch and the machine runs down the line. Sometimes such lines are automatic after the hoisting is accomplished, the telpher being started by the hoist clutch contact opening the switch, after which the automatic working is as previously described. The operator can stop the load at any point, and if an automatic device for dumping is supplied the load is dumped there.

The telpher crosses the river, 50 feet above it, on a steel bridge, and enters the mill at the third floor.

Of the three types of telpherage, however, the non-automatic, where the telpherman travels with his load, controlling every movement of the machine is much more commonly employed. In such case the telpherman may be his own loader, unloader, hoister, conveyor and depositor at one or many points along a line, and can

keep intelligent account of his receipts and deliveries. Mr. C. J. Messer of the United Telpherage Company, describes such a telpherage installation in New England, where cases of goods are carried between two buildings 1,200 feet apart. A pendant attachment permits the telpherman to lower himself 40 feet inside the building. Trap doors in floors permit his loading or unloading at any particular floor. If out of doors he loads and unloads from projecting platforms at each floor of the building. This transportation formerly kept three teams, and two men with each team employed. The cases were conveyed from the ground floor to the place required by elevator, each round trip requiring 20 minutes. The telpherman's trip takes but one minute.

The telpher with its load rounding a difficult curve.

In regular service the speed of the telpher varies from 300 to 800 feet per minute up to 20 miles per hour, or even more, when required. The slower speeds are used when the lines are short and where there are many curves, particularly for factory and foundry work. Grades are easily surmounted, the highest grade met in actual practice thus far being a 12 per cent rise. To carry half a ton on a level track at a speed of six miles per hour, much less than a horsepower of energy, including all losses, the actual figures being one-sixth horsepower, is required. This amount increases considerably with grades, and on very steep grades gears are used to avoid employing very heavy motors. The number of telphers used may be increased indefinitely up to the full number the tracks will hold.

At Milton, Mass., there was recently installed a telpherage line a sixth of a mile long for conveying material from a railway storehouse to a mill. Before the telpher line was in operation all the raw stock had been trucked by teams to the works over a long, circuitous route and was then carried by elevators to an upper floor of the mill. This involved a great deal of labor as well as a large number of teams and much time. The new telpherage plant takes the loads directly from the top floor of the railway storehouse and conveys them by the shortest possible route to the third floor of the mill.

The construction of this line involved some very difficult engineering. The only piece of level ground on the whole route was 60 feet beyond the storehouse. The track then turns a 90° curve of 40-foot radius and passes along the side of a rocky, precipitous cliff at the foot of which is a swift running river. On the rocky ledge of the river bank it turns another 90° curve, this one of 20-foot radius, passing over the roof of a house in turning the curve. The track then crosses the river, 50 feet above it, on a steel bridge, and enters the mill at the third floor. The construction of the steel bridge over the river presented the most difficult conditions.

On the level ground the track is supported by A bents 35 feet above the ground, resting on concrete foundations. Along the rocky cliffs huge supports of Georgia pine 14 inches square and from 30 to 40

feet long were used, the foundations for which were cut out of the slanting side of the solid rock. These supports are braced by heavy timbers in the shape of a figure 4, also anchored back in the solid rock. A single one of these posts weighs over a ton and a half. The steel bridge which spans the river carrying the track beneath it rests at one end on a tower supported by concrete foundation piers. The distance from this tower to the wall of the mill is 80 feet.

Along the side of a rocky, precipitous cliff, at the foot of which is a swift river.

The telpher, or electric locomotive in this plant, runs on top of the single overhead rail and is controlled by an operator, seated in an enclosed cab which is suspended from the telpher directly underneath the track. The operator has his controller, which is exactly like the ordinary trolley car controller described in the October Popular Mechanics, at one hand, and at the other hand is a powerful brake wheel, which applies the brakes simultaneously to the telpher and all of the trailers which carry the trucks so suspended beneath them, so the whole train can be stopped within its own length. Current is supplied to the telpher through trolley wires, being taken off by a trolley pole.

At the storehouse bags of raw material weighing 200 pounds each are loaded on trucks of 2,000 pounds capacity. The weight of the machine is 4,600 pounds, and with the three loaded trucks, the total moving load on the structure is 12,000 pounds suspended 50 feet in the air along the rocky cliff and over the water. The train is 30 feet long and the average speed is about 700 feet per minute.

The loaded trucks are pushed underneath the machine and the hooks attached. The operator raises the trucks several inches clear of the floor, then starts the telpher with its load of three trucks of 2,000 pounds each, and in three-quarters of a minute has passed by the precipitous cliff and across the river, and has landed his load of 6,000 pounds (three tons) on the third floor of the mill. The three loaded trucks are unhooked from the machine and pushed out of the way and three empty ones are hooked on in their place in less than a minute's time, and the operator is on his way back to the storehouse, where three more loaded trucks are awaiting him. The round trip has not taken three minutes.

By the use of this telpherway one man at $2.00 per day does in a day as much work as was formerly done by many men and teams. The cost of the power consumed by the telpher in operation for 10 hours does not amount to $1.00. Up to a 12-horsepower requirement, a gas engine consuming a few cents' worth of fuel per hour and a direct-connected generator will suffice for ordinary telpherage installations.

Mr. Messer describes conditions which have come under his immediate observation, and which telpherage is designed to economically replace. He says:

"Recently I stood forty minutes to observe the movement of five cases of finished cloth from a packing-room to a storehouse. In the operation six men and two horses were employed. Three men ended the cases upon a truck and wheeled them to the elevator; then a drop was made to

the ground floor. The combined effort of five men was used in getting the cases from the elevator to the platform of a dray. A driver handled the ribbons while the load was moving the 600 feet to the storehouse, the five lumpers being part of the load; then, at the other end of the line, the six men were required in the unloading of the dray and the conveying to another elevator, which in two loads took the material to the second story of the storehouse, where men, not accounted for in the illustration, loaded it again and wheeled it to its resting-place.

"It was rather a singular analogy that inside the buildings of the various departments of the manufacturing plant expensive machinery was being driven to its utmost capacity that the cost of production should be reduced, while here was at least 240 minutes of manual and animal labor expended in a simple problem of conveying. The cost of this operation, not including time of horse, interest on horse, wagon, harness, etc., was at least 60 cents.

"I will tell you what that 240 minutes was worth to the manager of that manufacturing plant and to his stockholders, if an equally careful surveillance had been exercised in indoor and out-of-door economics.

"Fifty cases of the same weight could have been transported between the same discharging and receiving points, the energy employed being a telpher outfit, a telpherman and a helper, and the entire cost, reckoning interest on plant, depreciation, power and wages, would be less than $1. I would like some mathematician to figure the loss in capital energy by reason of the cited carelessness on the transportation side of production."

In decided contrast to this Mr. Messer presents another picture:

"A 10-horsepower gas engine is furnishing electric power for the lifting of a 3,000-pound telpherage load at a speed of 60 feet per minute, and a horizontal run at a rate of 1,000 feet per minute, at an expense of 30 pounds of coal per lifting horsepower hour, and 12 pounds for the horizontal horsepower hour. During a recent test of eight and one-half hours' continual running in a ten-hour day, one-twelfth of the time was occupied in the lift, ten-twelfths in the horizontal run and a twelfth was lost in the changing of loads. The average per hour consumption of coal in the horsepower working hours involved in the problem was 13 7-10 pounds, or an actual power expense of 30 cents for the day's work."

In addition to the telpher lines we have already described there is what is called, technically, a space-covering track. It is a section of track placed between two side tracks, much in the way of a crane, except that the telpher passes upon the side rails across this immovable track to the other side. This enables goods to be raised from any portion of a floor or yard without switches or a multiplicity of tracks.

No other form of freight transportation is of more practical value to the manufacturer than this, which no known power save electricity could have made possible.

OPENED A BANK VAULT BY ELECTRICITY.

The combination of the vault of the Franklin Savings Bank, in Boston, refused to work a short time ago, and when every other means failed electricity was resorted to. The electrical experts were provided with a detailed plan of the bank and began operations during the night.

They made an electrical connection between a carbon and the wires of the power company outside the building, and with a 1,500-ampere current began to melt a hole through the door. The electricians were obliged to wear thick dark glasses because of the intense light made by the white hot carbon. Inside two and one-half hours a hole had been bored through the two and one-half inches of iron, when operations were suspended. Next morning the edge of a bolt on the inner surface of the door was chipped off by steel instruments and the door at last swung open.

LATEST FOOTBALL ARMOR.

Much like a knight of old now sallies forth the football player to battle for his college colors. The latest in this line is a patent football pants and suit. The garment is padded with felt at all points where protection is most needed. There are five grades ranging from army duck to expensive moleskin of the best quality obtainable. The pants and jacket are connected by an elastic belt which permits of free movement of the body. The pads have a great advantage over the old style which had a tendency to move out of place just when they were most needed.

Bucket Tramway in Mountains of Washington

Unique Conveyor a Mile Long--Descends 1,700 Feet--Is Self-Propelling

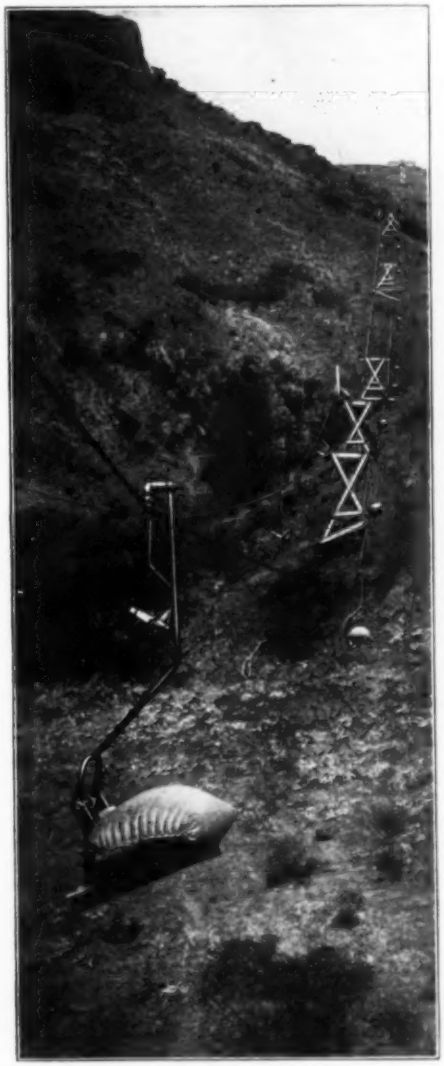
If some of the wheat grown in our great western fields could tell the story of its journey from the field across the country, through the vortex of the Chicago market and on across the ocean to the masses in Europe whose food supply annually depends on the American product, no doubt some strange methods of transportation would go on record, but no chapter would be stranger than the method by which it was conveyed from the big warehouses built at the top of river bluffs down those bluffs to the vessels waiting below.

When one thinks of the enormous product, the words "bucket tramway" convey an idea of an apparatus wholly inadequate to handle any great proportion of that product, and yet, far from being an insignificant apparatus, along the river bluffs of the great Northwest these bucket tramways convey hundreds of thousands of bushels of wheat every grain season, saving the farmers far around miles of hauling over rugged roads and rolling country.

One of these tramways is in operation at Wawawai, Washington, on the Snake river, carrying great quantities of grain down the steep bluffs of that river, a distance of 5,150 feet, from an altitude of 1,700 feet, to the warehouse and the steamers at the foot of the bluff.

Two immense warehouses were constructed, one at the top of the bluff and one on the bank of the stream, and between these operates the tramway. It consists of a strong steel wire cable, capable of supporting a very heavy strain. This endless cable is nearly two miles long, and is supported at frequent intervals, each support having a lubricated iron pulley, over which the cable runs. Strung along the cable at intervening distances of 80 feet are carriers, each capable of holding a sack of wheat. There are 128 of these carriers, so that 64 are constantly descending to the lower warehouse loaded, while 64 others are ascending to the upper warehouse to be reloaded.

This unique contrivance is operated by gravity, without the aid of any other power. At the upper terminal of the tramway is a large cast-iron wheel, 8 feet in diameter and supplied with a patent rachet grip, through which wheel the cable passes. A smooth band-iron grip-brake regulates the speed.



Conveying Wheat Down The Mountain

The construction at the lower terminal is the same. When in operation a man at the brake lever controls the entire tramway at all times. The sacks of grain are placed in the carriers as they pass, the loaded carriers

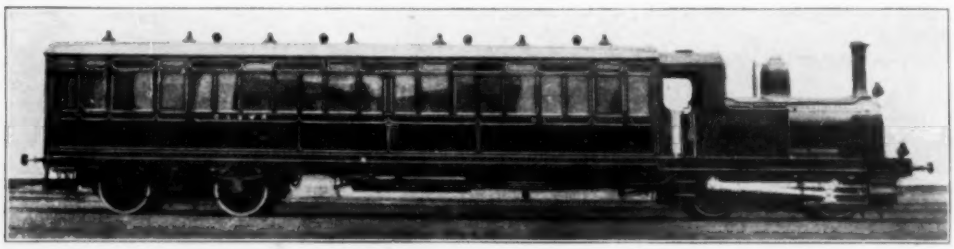
keeping the cable running, and down the side of the rugged, towering bluffs are continually passing the bags of good grain. The carriers are unloaded in the tower of the lower warehouse, and from thence the grain is carried in chutes to any section of the huge building desired, or, perchance, to the steamer in waiting.

This tramway can easily convey 200 tons of grain in ten hours, and during a grain season frequently handles from 75,000 to 80,000 sacks of wheat. The farmers for miles around haul their grain there, as it saves them trips of from fifteen to twenty-five miles to the nearest railway station.

COMBINATION LOCOMOTIVE CAR.

Will Be Tested on the Glasgow & Southwestern Railroad

With a view of securing more frequent service by running single cars instead of trains, James Manson, superintendent of motive power on the Glasgow & Southwestern, has designed the novel combination shown in the illustration. Page's Weekly, London, says:



Steam Motor Carriage for Local Traffic on the Glasgow and Southwestern Railway

The car, which is 60 feet 8 inches long over the buffers, is divided into three passenger compartments, and a special compartment for the steam motor; the one at the rear is a guard's compartment, the two adjoining being reserved for passengers. At the guard's compartment, steps are provided to enable passengers to enter from the road level, and these are so arranged that they can be brought into use by actuating a lever in the guard's compartment. Seating accommodation is provided for fifty passengers of one class, the seats being so arranged that there is a free passage from end to end of the car. Electrical communication is provided for the convenience of the guard and driver. Hand and vacuum brakes, which can be operated from either end of the vehicle, are fitted to each bogie, and in addition the steam whistle can be sounded from the guard's compartment.

ELECTRIC VS. STEAM LOCOMOTIVE.

Will the electric railway replace the steam locomotive?

Perhaps the best answer is that its future is not in the wholesale destruction of existing great systems. It is in the development of a field of its own, with recognized limitations, but of vast possibilities. It will fill that field to the practical exclusion of all other methods of transmitting energy; it will operate all street railway systems, and elevated and underground roads; it will prove a valuable auxiliary to trunk systems, but it has not yet sounded the deathknell of the locomotive any more than the dynamo has that of the stationary steam engine. Each has its own legitimate field, which will play its proper part in the needs of all civilization.—Frank J. Sprague, International Electrical Congress.

OIL PRODUCTION THE PAST YEAR.

The total value of raw petroleum produced in the United States last year was $94,694,050. Ohio led with $23,515,140; West Virginia, Pennsylvania and Indiana followed in the order named. Texas and California each produced over $7,000,000. During the year 18,880 wells were drilled, of which 4,650 were dry; these wells cost $26,402,000. The exports of petroleum and its manufactured products were $72,628,539, an increase in value, but a decrease in quantity as compared with the preceding year.

"Bends" or the Caisson Disease

Men Who Work in Compressed Air Suffer Agonies--Many Deaths Result--Science Investigates the Cause

In sinking the foundations of bridges, or in any work which must be done on the bed of the sea or of a river, the men work in a caisson, or large steel cylinder, which is sunk in the water, the water being kept out of it by means of compressed air. The bottom of the caisson is open, but the top is closed and men and materials enter through an air-lock, a chamber in the top of the caisson, which is fitted with airtight doors and cocks. By means of these cocks the air in the caisson is compressed or decompressed as required and at any rate desired. The large cock is used for rapid decompression during the passage of materials, but with men there is a deadly menace in rapid decompression, especially if they have been in the caisson some time or have been working under great pressure. Therefore a small cock is provided for slowly decompressing humans, though often the workmen are in such a hurry to get home that they scorn the dangers and make use of the large cock in order to get out of the air-lock quickly.

The men are never taken ill while under pressure, but often shortly after decompression some poor fellow is seized with terrible muscular pains, with cramps, his skin becomes icy cold and he breathes with difficulty; sometimes the pains in his limbs are sharp and shooting so that he is unable to walk and suffers agonies. Such cases generally recover in a short time, though they are apt to suffer again in a similar manner if they go back to the caisson; in fact, in severe cases, the employers, fearing the employes will die in a second attack, discharge them. Again, a laborer who has been decompressed perhaps an hour before, suddenly falls unconscious and lies a cold, livid, inert mass. Some parts of his body are sure to be paralyzed, the pulse is irregular, the heart-beats scarcely audible, the pupils of the eyes do not move. Perhaps the attending physician tries bleeding the patient; his blood is black. Such a case is inevitably followed by death. This terrible disease, which men brave in order to earn bread for their families and themselves, is known among workmen as the "bends" and among physicians and scientists as the "caisson disease."

The construction of every bridge where the caisson is used for the foundation work adds to the list of those who die or suffer from this disease. At Brooklyn Bridge there were 110 cases of illness with three deaths; while sinking the foundation of the Eads bridge across the Mississippi at St. Louis, of 600 workmen there were 133 who suffered from bends in varying degree, of whom 14 died. Of 64 men employed in a caisson on the banks of the Loire, 25 had bends, 16 having serious attacks and two dying. This latter instance occurred as far back as 1854, but time has not bettered conditions, nor removed the cause. The following paragraph which appeared in one of our reliable newspapers during the present year repeats the story:

NEW YORK, Sept. 17.—That fourteen men have been killed in the new Manhattan bridge caisson within fourteen days was learned today during a discussion by several British engineers, who were inspecting the south tunnel under the Hudson river. The deaths have been kept quiet, as it is hard to get men to work in the caisson. Death in every case was due to the caisson disease, paralysis resulting from working in the high pressure chambers.

These are terrible statistics for this day and age, and engineers, contractors, scientists, physicians, men of prominence everywhere are taking note of the fact and investigating it. Even the lawyers are interested, as it presents opportunities for endless litigation.

For every 33 feet of depth that the caisson is sunk in water, +15 pounds pressure to the square inch or +1 atmosphere is required to keep the water out of the caisson. Therefore if the depth were 100 feet, the pressure would be 45 pounds to the square inch. The effects upon the system while under pressure are all of a minor character, more of the nature of inconvenience than of injury. The pressure has no mechanical effect on the circulation. It causes pains in the tympanic membrane, which are relieved by opening the Eustachian tube, the pulse and the respiration are slower and there is a feeling of resistance to movement, due to the density of the atmosphere. One cannot whisper under pressure, and if he whistles he can hear no sound.

An old Scotchman who worked in one of the Blackwall tunnel caissons where the

pressure was as high as 37 pounds to the square inch gives a graphic account of how he felt while inside the caisson:

"We stayed in for eight hours at a shift. We had half an hour for dinner, but some of the men would not come out for it. They took it inside with them. Coming out again it was not so bad, but just chilly; bitter chilly, cold as charity. The pains would come on afterward, in an hour or so, or when you got into bed. Bends in the back, and the wrists, and the legs; just awful. Men would turn out in the middle of the night and come back to the works and get into the compressed air again in the medical locks. They had a full dose of it for a start, and let the pressure drop gradually. Then they went back home to bed. Do them any good? Eh, mon, it's no for me to say. They said so, but I thought it was only humbug, a faith dodge. When I had bends I just jumped about and took a drap of guid whuskey.

"I never felt happier than when I was in the compressed air. Always happy, and on the cheery side. Why, laddie, I would get up in the morning feeling very dour and queer, and just go into the workings, and then whistle and sing all day long. Not that you could hear the whistling, at least a man with my lungs, when the pressure was over twenty-five.

"The worst thing that could happen was for the electric light to fail. Then they burnt candles, and the mixture of smoke with the air gave them 'bends' of an extra special vigor. You nodded and didn't care if you went to sleep forever, though it was all very nice and dreamy. When I was alone in that 'casoon' I had to rope myself up lest I should fall asleep and tumble to the bottom, 60 feet below. It was better under the river than in the 'casoons,' because under the river the air could escape into the Thames. Tobacco had no sting. The only stuff that had any flavor was four-ale. You weren't allowed to take it in, but you did. But you had to take the cork out first. If you didn't the bottle would burst. The finest men in the tunnel were the first to be knocked out. The men of delicate appearance stood the pressure best."

The results of a thorough investigation of this subject made by Leonard Hill, M. B., F. R. S., lecturer on physiology at the London Hospital, and J. J. R. Macleod, M. B., professor of physiology at the Western Reserve University, Ohio, was recently published in the Journal of Hygiene.

These authorities declare that the cause of the caisson disease is the escape of gas bubbles in the blood vessels and tissue fluids on decompression. These air bubbles coalesce and increase in size and, flowing on with the blood, gather at all the high points, just as in a pipe system, and there remain until forced at a gulp toward the heart. If sufficient time is taken in decompressing the men they do not suffer from bends, but the length of time of decompression must vary with the length of the shift. The disease has a wide variety of symptoms: pains in the limbs, vertigo, nosebleed, embarrassed respiration, hemorrhages, intense cold due to the expansion of the air, loss of muscular power, paralysis, some cases even have become disabled for life, amputations of limbs being necessary. Diver's sickness comes under the same class.

Is it at all strange that caissoniers are hard to get? But there is a means of preventing this terrible disease that maims, disables and destroys. The first step rests with the employer himself. Let him see that the airlocks on caissons have adjustable locked escape valves so that the men cannot get out in less than sufficient time for decompression. Let him see that the time of decompression does vary with the depth of excavation, and the pressure of air and let him make sure the shifts are not too long.

Men not older than from 20 to 25, small, spare, and totally absteminous, should be employed. It is no place for old or fat men. After a test at low pressure all who suffer from symptoms should be discharged. The longer the shift, the greater is the saturation of the body fluids with gas, and the slower therefore should be the decompression. The higher the pressure, the shorter should be the shift, and the longer the decompression period. For a pressure of +2 or 30 pounds the shift should be four hours and the decompression period from 30 minutes to one hour; for a pressure of +6 to 7, or 90 to 105 pounds, about a 45-minute shift and a decompression period of two hours. The decompression chamber should be artificially warmed and the temperature not allowed to fall below 60 degrees F.; ventilation should be thorough during decompression. The caisson should also be freely ventilated and kept at a temperature of 60 degrees F. The men should remain quiet for an hour after decompression and if symptoms appear should be hurriedly recompressed. If these rules were followed strictly it is safe to say that there would be few fatalities from this disease.

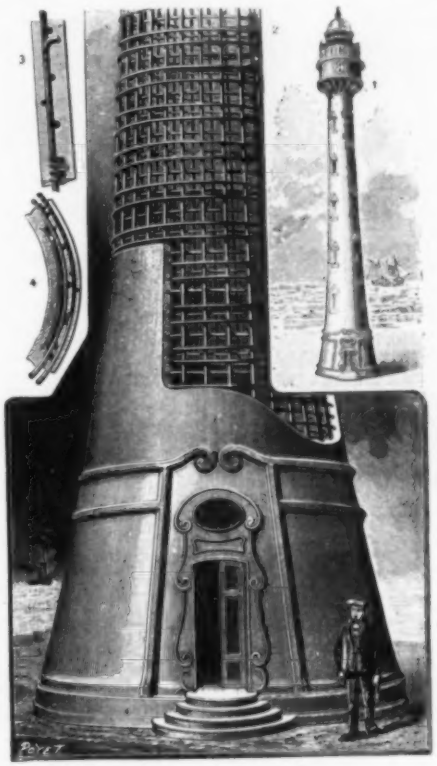
TALL BETON AND STEEL LIGHTHOUSE ERECTED BY RUSSIAN GOVERNMENT.

A recent consular report declares that beton is believed by German contractors and manufacturers to be the coming building material, in that it is cheap, durable and the least susceptible to fire of all building materials now in use. Beton is not, however, a new building material. It was invented by M. Coignet, a Frenchman, who spent many years experimenting with it, and some of the most interesting exhibits at the Paris Exposition in 1867 were of this artificial stone.

It is so much like concrete that it is often confused with that stone. Beton, however, is composed of from four to five parts of clean silicous sand, neither too fine nor too coarse, one part of either common or hydraulic lime and hydraulic cement, one-fourth to three-fourths of one part in volume. These solids are thoroughly mixed with just enough water to convert them into a stiff, viscous paste, so that every grain of sand or gravel is coated with a thin film of paste, and is then rammed into moulds with heavy iron pestles. It is an artificial stone of great strength and hardness and has been in the past used extensively in submarine works. Its great property is that it successfully resists the solvent action of the salts and certain gases contained in sea water, and is not injured by climatic influences and changes. For instance, freezing serves only to detach a thin scale from its outer surfaces, leaving it slightly rough and somewhat unsightly, but otherwise perfectly capable of holding its own for long years against storm and tide.

The first important lighthouse to be constructed of beton and steel has just been completed by the Russian government at the entrance of the canal which connects the fort and naval base of Nikolaev with the Black sea. This lighthouse is 132 feet, 2 inches high above the ground, and one of the strongest in the world. It is paraboloidal in form and rests upon a massive base of beton 19 feet, 8 inches in diameter, 7 feet, 2 inches high, encased in steel, covered on the outside with beton and buried in the ground to a depth of 8 feet, 2 inches. At the base the lighthouse tower is 20 feet, 8 inches in diameter, and 6 feet, 6½ inches in diameter at the crown.

The coating of beton on the tower walls is comparatively thin, at the base being only 7⅔ inches thick; at a height of 40 feet, 5⅚ inches thick, and at the top 3⅚ inches thick. The great strength of the tower depends not on the beton, but on the steel frame which the beton encases and protects from corrosion. This is composed of transverse and longitudinal steel bars



Beton and Steel Lighthouse Erected by Russia

nearly an inch in diameter, the transverse bars being in circular sections and sunk into the beton to a depth of 1.18 inches. The bars are closer together towards the base than at the top; Figs. 3 and 4 show the manner in which they are joined.

At the top of the tower there is a large room which serves as a storehouse and also for the keepers to keep watch from. Above this room is the lantern tower and the whole is surmounted by a cupola.

The total weight of the lighthouse, including the filling of beton in the massive foundation is estimated at only 507 tons, its cost was but $6,270 and the time required for constructing but two months.

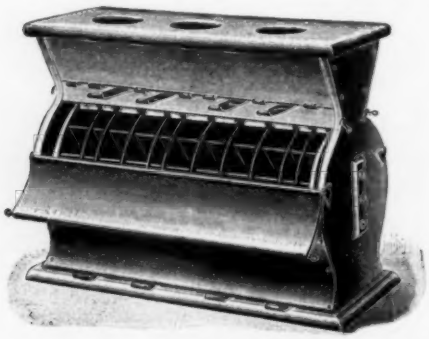
The superiority of this construction for such purposes is being widely discussed.

Beton is much more generally used than hitherto for public buildings and even residences. One of the most important works in which it has been used is a section 37 miles long of the Vanne acqueduct for supplying water to Paris. This aqueduct passes through miles of the Fontainebleau forest and comprises from two and one-half to three miles of arches, some of which are 50 feet high; eleven miles of tunnels and eight or ten bridges of spans from 75 to 100 feet.

The cost of this artificial stone varies with the cost of lime, but all the substances used in it are so generally obtainable that in almost any country it is comparatively cheap.

BEST FLOUR FROM MIXED WHEAT.

In flour mills one grade alone of wheat is seldom used, but a process of what is termed blending is resorted to. This has heretofore been accomplished by elevating the various grades of grain into bins, from which it runs down in spouts. By opening and closing these spouts the proportion of the several grades is secured. A machine



Automatic Wheat Blender

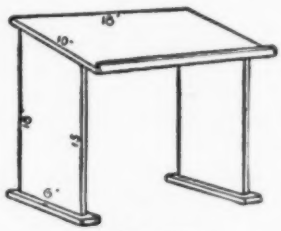
has now been devised for blending which can be adjusted to a nicety.

The machine is very simple in construction and consists of a cylinder with compartments of different sizes fed by drawing a slide over each. In this manner the flow of the grain is regulated and the amount going to each compartment can be accurately adjusted. It is operated by gravity.

Many fishermen are using graphite for polishing their lines. It renders the lines more impervious to water and greatly facilitates the movement of a line in casting.

A DESK FOR A CHILD.

The little desk shown in the illustration is just high enough for a child when seated in its chair to draw over its lap and rest slate or book upon. It is an exceedingly comfortable piece of furniture for the tot who has just started to school and spends



Child's Desk

many minutes laboriously trying to write. All materials for such a desk could be found in most homes. It is made of three pieces of board, a molding for the front, and the top covered with cretonne put on with brass-headed tacks. The sides may be stained and so made much more attractive.

HIGH SPEED REQUIRES SINGLE CARS.

German engineers have decided that very high speed must be made by single cars; there is too much danger of the trailer jumping even a straight track. The power required makes the service expensive. Who would think that the soft balmy air of a June morning would alone offer a resistance requiring 1,100 horsepower in addition to the 200 horsepower necessary to propel one car when moving at 120 miles an hour. Such, however, is the carefully made record of the celebrated experiments with an electric car at Zossen. A standard gauge electric surface line is to be built connecting Berlin and Hamburg, a distance of 160 miles. The trip will be made in two hours.

The Wall Street Journal says: "There will continue to be a tendency toward heavier coaches so long as trains run on present track. The lateral oscillation of wheel flanges and the tendency to lift the train free of these flanges when passing over irregular track at great speed are objectionable."

The Railway Age says: "As the schedule speed increases, the weight of train and the number of cars decrease, and it is not possible to haul present trains of eight or ten

Pullman cars at sustained speeds of 65 or 70 miles per hour with either steam or electric locomotives. Electric traction at a speed exceeding 100 miles per hour will probably be with a single car, and such a car with motors sufficient for the purpose, and capacity for the necessary number of passengers to make it profitable, will be heavy enough to hold itself down to the track of regular gauge, and it will not be necessary to resort to the more expensive construction required for the mono-rail."

GOATS ON ARIZONA RANGES.

Goat raising is on the increase on the ranges of Arizona, says a bulletin recently issued by the Bureau of Plant Industry. The carrying capacity of Arizona range lands are stated to vary from one bovine to 50 acres to one to 100 acres. Goats on these ranges live upon oak brush principally and from their hardy character they are better adapted to the arid country than most other domestic animals. Cattle frequently travel 10 miles from water to feeding grounds, making a distance of 20 miles between waterings, while sheep are often herded at a distance of six miles, making 12 miles' travel for them. Sometimes when the distance is too great, the ground near an arroyo will be thickly strewn with the carcasses and skeletons of dead cattle.

Goats Feeding on Oak Brush on an Arizona Range

ENGLAND ENCOURAGES COTTON GROWING.

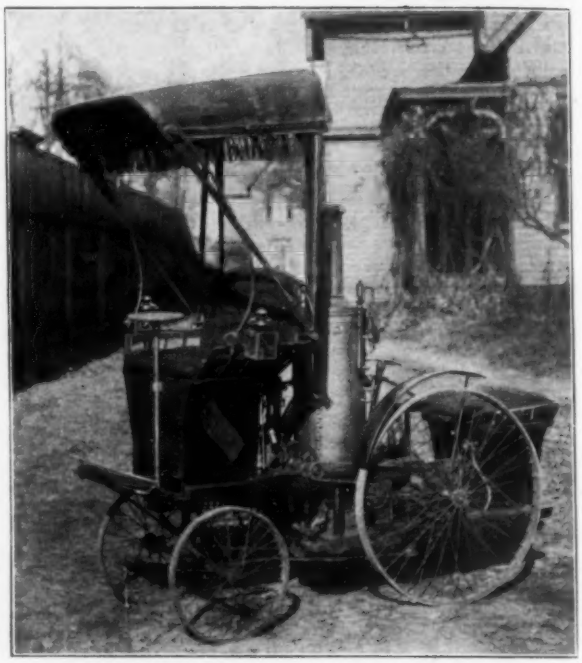
England is making extraordinary efforts toward the promotion of cotton cultivation in the West Indies. Four thousand acres are to be planted with cotton in the Windward and Leeward Islands and Barbados. Cottonseed is furnished free. The government is aiding in the establishment of factories for ginning and baling. The first of these factories has just been completed at Bridgetown, Barbados; another is being built at Antigua and a third is to be built at St. Vincent.

AUTOMOBILE SCHOOL FOR HORSES.

It is not a difficult task to educate the average country horse to understand an auto will not harm him, if only one will take the pains to train him. The Motor Age describes such a school for horses which a lover of horses—and autos—conducted the past summer on Mt. Washington. The first lesson was to run the automobile into the stable containing more than 100 horses. At first there was a great commotion, some of the horses even laying down from sheer fright. Feeding sugar to the horses from an automobile was one of the alluring lessons which worked well. One week's training was sufficient in most cases.

FIRST AUTOMOBILE IN THE UNITED STATES.

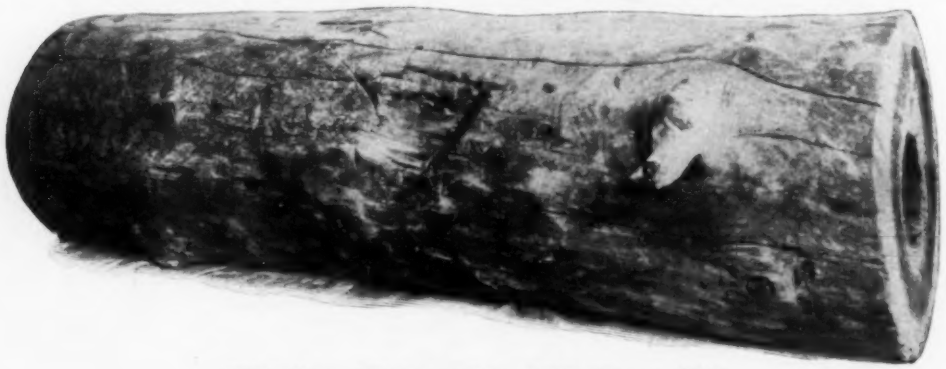
What is claimed to be the first automobile built in the United States, is still in operation and is owned by Achille Philion, of Akron, Ohio. It was fourteen years ago that he had the machine built under his direction. The picture affords a very fair idea of the construction. The motive power is steam; the upright boiler burns coal; the engine is one horsepower; and the wheels are wire-spoke with flat metal tire. The steering wheel is quite similar to present practice, while the whistle is something of a novelty. Two persons find comfortable seats in front, and the rear seat is for the engineer who is also fireman, and who controls the operation of the engine.



Claimed to Be the First Auto

Piece of the Water Main Used in New York City 107 Years Ago

While workmen were excavating in the New York subway, they came across a piece of wooden water pipe which had been laid in 1776 and which represents a part of the water system of that great city 107 years ago. The piece in the photograph is four feet long. The entire piece uncovered measured 20 feet in length. This was part of a main supply pipe. The diameter of the log is 30 inches and the diameter of the hole through the center of it is three inches. Just how this hole was bored through a 20-foot length would no doubt be interesting to know. This old pipe was unearthed at a depth of 40 feet. It is in a good state of preservation. New York's water supply 107 years ago is said to have come from springs in the vicinity of Canal street.



Wooden Water Main 107 Years Old

The Gas Engine on the Farm

That handy machine, the gas engine, which has filled so many niches and is adapted to so many requirements in the various crafts, is nowhere growing in favor more rapidly than on the farms of America, and in a short time undoubtedly will be classed as a necessity among the equipment of farm machinery. The farmer has learned many things since the telephone did the pioneer work and brought the rural districts into closer touch with metropolitan centers, and not the least of these is that he has long been the slave of much needless drudgery.

One of the great advantages afforded by the gas engine is that the man who has but a few acres to cultivate need not buy a powerful engine, but can secure one of just the horsepower that will do his work. If he has 80 acres a 2½-horsepower engine will be amply capable, but if he owns a quarter-section, he will need not less than a 4-horsepower size. It is astonishing the amount of work the 4-horsepower engine can perform. It will operate the washing machine, the separator, the churn and the pump all at once, if desired, and with a great saving of human energy. In a single day it will shell seven or eight hundred bushels of corn; it will grind two bushels of corn an hour for each horsepower used, and in running the wood saw it will require three or four men to handle wood enough to keep it busy.

On a great many large farms an 8-horsepower traction engine is used for drawing the binder and a gang plow and for running the shredder, feed grinder, wood saw

Fig. 1

and ensilage cutter, while a 2-horsepower gas engine is used for the lighter work, such as running the grindstone, emery wheel and churn and for pumping water. In cold weather the water is pumped direct to the drinking tank and the stock accustom themselves to the drinking hour once or twice a day.

The farmer with but 80 acres or so of land stands more in need of a gas engine, however, than does the operator with the larger farm who has his traction engines and other up-to-date appliances to fall back upon. A 2½-horsepower engine will pump

Fig. 2

the supply of water for the entire farm, the water being piped to house, barns and grounds as desired, and it will run the churn and the grindstone while pumping.

A correspondent of the American Blacksmith tells how he mounted such an engine on some 18-inch plow wheels which he procured of a junk dealer and when shelling corn first located the sheller wherever he wanted it and then located the engine accordingly. He says:

"We use a two-hole sheller, wagon box elevator and wagon box cob carrier. It takes about half of its power to shell fifty bushels an hour; the engine is moved around as easily as an empty wagon. The feed grinder is a six-horse size; it will take all the work there is in the engine. It will grind from four to eight bushels an hour, according to condition of grain, the condition of grinding buhrs, or the fineness ground; usually five bushels an hour, about two hours a week. The words 'no smoke, no ashes, no engineer' clearly express the facts, for once understood it is easily managed, and will run for hours without an attendant. A gallon of gasoline will run my engine for the pump about twelve hours; it costs less than one cent for gasoline to grind a bushel of grain. In the spring, when chicken feed is wanted, and in the fall, when new mush is wanted, I do grinding enough for others to buy my gasoline for most of the year; the expense is so small that it would not get an accident

policy on your life to climb a wind mill tower to oil it. One day when husking, a hydrant was left open. We came in from work at night. There was no water, and no wind to run a wheel. The engine was started and in a few moments there was water for things, and by the time chores were done there was three or four days' supply of water on hand."

In the accompanying sketches we show several methods of fitting up wood sawyer's outfits with the gas engine. The portable

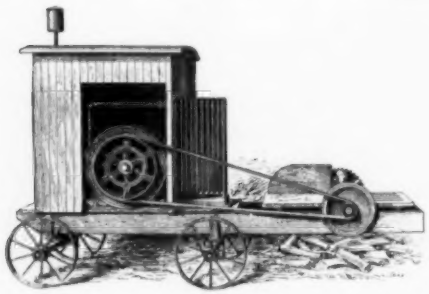


Fig. 3

outfits when fitted up with an engine of from 4 to 10-horsepower are suitable for sawing logs as well as cord wood and so are especially adapted for taking into the timber.

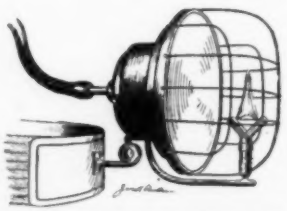
On a great many farms much of the repair work is done in the farmer's own shop and in many of these shops the work is heavy enough to admit of the use of the gas engine. In Fig. 1 is shown a wood-sawing outfit geared to the engine which is stationed within the shop. The size of the circular saw of course varies with the size of the wood to be handled, and the size of the saw or wood determines the amount of power necessary to run the saw. With soggy wood greater power is required than with clear-grained wood. For handling cord wood a 22 or 24-inch circular saw with a heavy balance wheel of from 25 to 100 pounds and run by a 2 or 3-horsepower gas engine is large enough and will saw from 10 to 30 cords of wood per day, according to the amount of help engaged in handling the wood. There should be one man to operate the saw and another to deliver the sticks to the saw table. Larger saws require more power; for instance, four horsepower would be required for a 26 or 30-inch saw and, in fact, a 5 or 10-horsepower engine could be used advantageously with greater speed and more rapid work.

In the portable outfit, shown at Fig. 2, a 3-horsepower water-cooled engine is used. In the case of a water-cooled engine there is risk of the cylinder freezing in cold weather and therefore the water tank must be emptied when shutting down and refilled when the engine is again started up. The tank holds but a couple of pailfuls of water, so the work of emptying and filling it is slight.

The outfit shown at Fig. 3 has a 6-horsepower oil-cooled cylinder so that the trouble of emptying and refilling the cylinder is done away with. The construction of each of the portable outfits is apparent in the illustrations and, of course, each is capable of being modified or changed according to individual circumstances. A search through the junk pile will probably yield all the materials required outside the saw and the engine, and with the aid of a farm hand any farmer can fit up such an outfit in half a day's time.

SURGEONS' ACETYLENE HEADLIGHT FOR OPERATING AT NIGHT.

In the modern hospital the operating room is specially equipped to secure the greatest possible amount of light, both day and night. The walls are of the finest and whitest enameled brick obtainable, and a large skylight by day and innumerable electric lights at night simply fill the room with a bright light. A skillful surgeon can, in emergency, get along without many of the most helpful appliances, but he must have light.



For the special assistance of surgeons who are obliged to operate at night outside of the hospital, Dr. Kane has devised an acetylene light which throws an intensely bright light just where it is most needed. The burner and reflector are worn on the forehead of the operating surgeon, and the gas conducted through a small tube which runs down the doctor's back to a little generator fastened to a belt at the waist.

SHOP NOTES

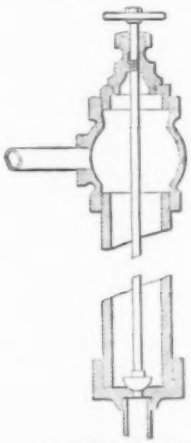
HOW TO MAKE A STEAM TRAP.

A steam trap should always be open when empty, so that when the steam is turned on the water will drain out of the pipes and the pipes can drain themselves after the steam is turned off.

The home-made trap shown herewith includes this advantage and also has the advantage that by the valve arrangement in its top the amount of steam can be regulated according to the requirement.

It consists of 3 feet of 2-inch pipe with a cap on the bottom and a cap on the top, and the stem and gland of a ¼-inch valve inserted in the top. That stem is attached to a brass rod 5-16 inch in diameter.

On the bottom of the rod is a little hemispherical piece of packing, which is sufficiently hard to resist the action of steam. Anything softer than this, the steam will melt away. The ratio of expansion of brass and iron is practically as three is to two; that is, you will have three points of expansion in brass to two in iron. Steam at 50 pounds pressure contains 297 degrees of temperature. Taking 200 degrees as the difference between the inlet steam and the outlet water, a 30-inch trap gives nearly 1-32



Home-Made Steam Trap

inch in expansion, which is sufficient to drain the trap.

Turn the steam on, and the water will come out of the half-inch pipe and fill the pipe at a low pressure. As soon as the steam begins to come, the rod will close the valve entirely. After that it will open itself slightly and allow the water to trickle out in a hot stream.

HOW TO STRAIGHTEN PAPER.

Who has not been annoyed by blue prints, drawings or other papers which, having been rolled for some time, refused to lie flat when in use? And yet it is a very

To Straighten Paper

simple matter to straighten the paper so that it will give no more trouble.

Hold the paper by the corners or by the ends and draw down over the sharp corner of the drawing board or table, or else lay the hand on the sheet at the table edge and draw the sheet through with the other. In this way it can be easily straightened. The illustration is by courtesy of the Draftsman.

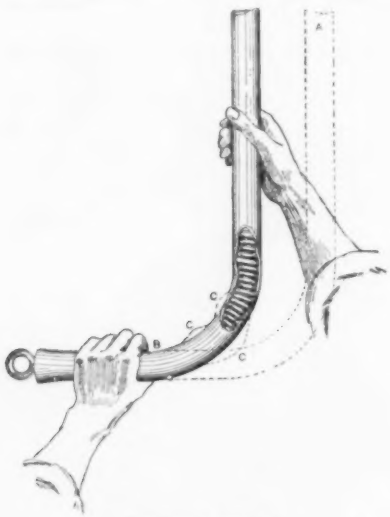
FORMULA FOR WHITE METAL.

A formula for making white metal for motor bearings, which has given excellent results on heavy high-speed service, is given in the Mechanical Engineer, of London, and consists of 48 pounds of tin, 4 pounds of copper, and 1 pound of antimony. The copper and tin are melted first, and then the antimony is added.

PROPER METHOD OF BENDING LEAD PIPE.

Making bends in lead pipe is not difficult, but to make a neat round full-sized bend the workman should be properly equipped with bending tools, says the Metal Worker.

The rubber bender on the market today, consisting of a piece of solid rubber 18 inches long with a rope molded into one end, has certain disadvantages. In use, it is greased and inserted in the pipe to be bent which is then bent over the knee, giving a



Bending Lead Pipe

sweeping curve. There are many instances where a square bend is necessary, but this cannot be had by use of the rubber bender without heating the pipe, which in time injures or destroys the bender, also there is not enough heft in the bender to allow of the pipe being dressed sufficiently to compensate for the thickness in the heel of the pipe. A very important point.

The spring bender, consisting of a spiral spring wound close together with a loop at the end for removing it, and usually, 24 inches long is, generally speaking, much handier.

Before making a bend with the spring drift out the pipe and dress smooth. Grease the coil bender and place full length in the pipe and then, with the handle of the dresser, strike the pipe at the point where the throat of the bend is to be, hard enough to dent the lead slightly. Heat the throat of the bend and the pipe for four inches on each side of the heel of the bend over the furnace until it is so hot that water splashed on it will fly off. Place the pipe on the floor and hold a piece of carpet or a bunch of rags tightly in the throat with the left hand while the right hand bends the pipe up to an angle of about 45 degrees, thus thickening the lead in the throat and thinning it in the heel. Dress out any kinks that may show up by striking the lead in such a manner as to draw any surplus lead from the throat to the heel.

Heat the lead as before; with one hand grasp the short end of the bend close to the throat and with the other hold the long end upright and jump or pound the pipe on the floor, as shown in the sketch. Strike a few sharp blows on one side, reverse the pipe and repeat the operation on the other end, occasionally dressing the lead from throat to heel. In pounding the lead on the floor, strike with a sliding motion, thus forcing the lead from the pipe to the heel (C C C). The bend will soon be square and the pipe should then be dressed perfectly smooth.

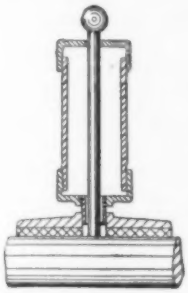
To remove the spring insert the bending iron into the loop of the spring, place the foot on the pipe as close to the throat as possible, and then proceed to twist the spring as though winding it up. It will reach a certain tension and then turn suddenly, when it will be as tight as before. Now twist it again, and just before it turns commence to pull, and at the same time keep twisting. If the pull is kept up until it turns, it will spring out about six inches, after which the operation must be repeated until the spring is removed. After the knack of pulling at the right time is acquired, there will be little trouble in removing the spring.

When a bend is to be made in the center of a long pipe or when a spring cannot be had, the old time sand method is a handy thing to know. The sand should be clean and fine. Place it in a pan and suspend over the furnace to heat it hot. Close up one end of the pipe to be bent by soldering or beating over the edges of the pipe as far as possible. Ram a small bunch of oakum down the pipe to fill up the hole. When the sand is hot pour it into the pipe to the depth of a foot at a time and pack thoroughly by dressing the pipe till the sand will stand no more. Close the other end with either a wooden sand plug or as the first one was closed, being careful to dress the lead down tightly on the sand so

the sand will have no room to loosen up and cause kinks in the pipe when bending. Make the bend just as it is made when using springs. Do not press hard on the bend, but strike light blows. Hard blows will cause the lead to spread and so loosen the sand; light blows set the lead up against the sand.

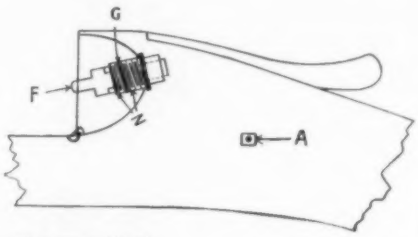
HOW TO MAKE A GREASE CUP.

Take a 1½-inch nipple about 4 inches long and on each end screw a cap. On the cap leading to the bearing there should be a ½-inch nipple and the top cap should have a hole for the brass rod to pass through. The rod is heated by the friction between it and the shaft and this causes the grease to flow down it to lubricate the bearing. The cup is convenient for bearings which are not attended to often, says the Practical Engineer.



WANTS TO REMOVE BROKEN FIRING PIN.

I have noticed several "kinks" in the line of getting out broken studs, screws, and tapper pit rods, but have never read of one just like the one in sketch I enclose, and would be pleased to hear from some of your

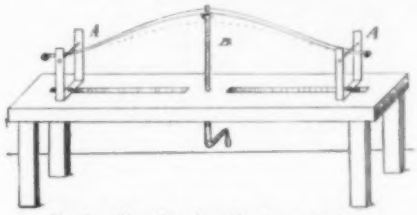


A. Hammer Stud.
B. Breech Block.
G. Position of Cock.
F. Firing Pin.
N. Nipple.

readers as to how they would get at it. The firing pin is slightly damaged and must be gotten out, but only the fore part of the nipple can be turned out in the ordinary manner.—Wm. Nak, Rural Route 14, Grand Rapids, Mich.

HOW TO SHAPE CARRIAGE SPRINGS.

There are only a few carriage smiths, nowadays, who make their own carriage springs, but it is, nevertheless, convenient to know how to do it, and there are out-of-the-way places where the smith is obliged



Device For Shaping Carriage Springs

to make his own springs for every job he builds.

The device herewith shown is handy for shaping the springs after the heads for the main leaves have been made, the smaller ones drawn to taper, the center holes drilled and the ribs and grooves for keeping the holes in place made, says a correspondent of the American Blacksmith.

In shaping the springs in the device hold the ends in place by means of bolts passing through forked irons, as at AA. Force the center up slightly as at B by means of a screw. Heat the second leaf its full length and then with tongs and clamps, bend it to fit the shape of the main leaves. Shape the remaining leaves in the same manner over the one preceding each, moving the forked irons closer together as required, according to the length of the leaf.

All springs should be tempered, but the tempering cannot be done satisfactorily in an ordinary forge, for in order to obtain a uniform heat the full length of the leaf, the fire must be long enough to heat it all at once and not too quickly, but gradually, to be sure the heat penetrates the steel. A coke furnace is best for the purpose, heating the spring as for bending and performing the work quickly, then spraying the leaf with water until it is nearly cold. This is sufficient for cheap grades of work, but for the better class the springs should be oil tempered. To do this fill a trough or tank, large enough to allow of dipping the leaf until cold, with linseed oil. After dipping the leaf, draw the temper by placing it over the fire until the oil is burned off.

A good shellac varnish is made of 3½ pounds orange shellac thoroughly dissolved in 1 gallon of wood alcohol.

RECIPE FOR MARINE GLUE.

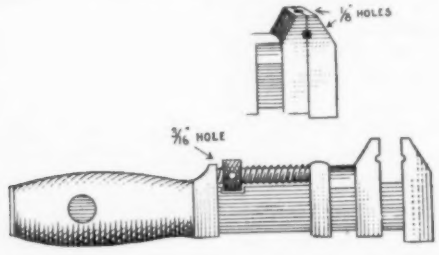
One part of pure india rubber dissolved in naphtha. When melted add two parts of shellac. Melt until mixed. Pour out on tin until cold. Melt and use with a brush at water-bath heat.

Or take a handful of quicklime and four ounces of linseed oil. Boil, and pour out on a plate until hard. Melt and use.

Or take one pound of common glue—not fish glue—in two quarts of skim milk. Soak and boil. All these are good.

TO USE WRENCH AS HAND VISE.

A clever idea comes from W. I. Livingstone, Whitman, Mass., who says: "The inclosed sketch is of a 6-inch Coes wrench which I have improved by drilling a 3-16-inch hole in the knurled thumb-piece. This



Wrench as Hand Vise

enables one to insert a punch or piece of rod in hole and so obtain a greater leverage. This makes a good hand vise with parallel jaws. By closing jaws together and drilling down and across between jaws with ¼-inch drill, round pieces may be more securely held."

MELTING BRASS IN AN OIL FURNACE.

"For melting a good grade of metal for a fairly heavy class of work such as building locomotives, rotary oil furnaces are less expensive than crucibles," declares a correspondent of the Foundry, "but for a very light class of work, such as melting yellow brass, the crucible is best." Manufacturers of crucibles claim there is a great loss in shrinkage of metal when melting with oil. To sustain his statement as to the advantages of the oil furnace the writer makes the following comparison:

"In the foundry I am going to use for illustration they cast 3,000 pounds a day on an average, and up to August 1 used the crucible furnace. They used two sizes of pots, Nos. 200 and 150. Of the No. 200 size they used on an average, 12 a month at $10 apiece, making $120. Of the No. 150 pot, four a month at $7.50 apiece, or $30, making $150 for crucibles alone; for 3,000 pounds of brass it will take 2,250 pounds of coke at $5.25 a ton, which is $5.90 a day for coke; costing $153.40 a month for fuel with a loss of shrinkage of metal averaging 2¾ per cent. They melt all good brass of a mixture of 50 per cent new metal and 50 per cent of scrap. The new metal is copper 80, tin 10, lead 10, and small per cent of phosphorus. The scrap is all railroad scrap, running in weight from ½ pound to 30 pounds apiece. Ten days after the furnace was running the fireman charged 1,100 pounds of metal, 50 per cent new and 50 per cent scrap, and got 1,076 pounds of castings and sprues, making a loss of 2 2-11 per cent, and in the crucible 2¾ per cent of loss, a saving of loss in melting. To melt 3,000 pounds in the oil furnace at 2 gallons of oil to 100 pounds of metal, with oil at 3½ cents a gallon will cost $2.10, quite a saving over $5.90 for coke to melt the same amount of metal. The total cost of a month's run in which 78,000 pounds of metal was melted was as follows: When using the crucibles, $303.40, and when using the oil furnace, $54.60. The difference making a saving of $248.80 a month not figuring the cost of lining furnaces, either oil or crucible.

"This oil furnace has two chambers, and while melting in one side the heat has to pass through the other side to find an outlet, and by doing so heats the metal almost to a melting point; so that in melting the second heat on the other side the cost of oil is very small, as two gallons for a hundred pounds of metal is a high figure.

"The cost of the furnace is $950, all put in place and ready to melt, and the only extra cost is a small fan, say $1,000 all told. This company was using oil in their plant for other purposes, so all that was needed was to connect the pipes to their oil tank. If the oil tank had to be put in it would cost more. But to compare the two ways of melting, the furnace will pay for itself in less than four months, and besides it is not so hard on the melter, and does not keep the shop so warm. You can put your hand on the oil furnace when it is melting and not burn yourself."

PASTE FOR DRY BATTERY.

The following is from Bubier's Popular Electrician:

Plaster of paris, 1 pound; oxide of zinc, ¼ pound; saturated solution of chloride of zinc, enough to make a thick paste. Make a zinc box, putting your carbon element in the center, at the same time insulating the carbon from the bottom of the box with a piece of fiber. Fill the box with the paste and seal up tightly, insulating the carbon from the top of the box with fiber also. The zinc forms one pole and the carbon the other.

The most effective way of de-magnetizing a watch is to place it inside a coil of wire through which an alternating current is flowing. Hold the watch by the chain and twist it slowly, by turning the chain. After this treatment for four or five minutes, gradually withdraw the watch, still revolving it. A common method pursued in electric light stations is to lay the watch down on the sheet iron core of the transformer. A piece of wood should be placed under the watch to protect from injury by the heat.

CHASER FOR CUTTING THREADS.

"Last week I made a chaser for cutting or recutting threads in the lathe, by hand. For 1-inch thread put a 1-inch pipe tap in the lathe and set the gears for 11½-inch thread. Then put the chaser in the tool rest and feed against the tap just a few times up and the tool is done. I have been a machinist 17 years but have not seen this method printed."—Contributed by I. H. Gingrich, 328 First St., Grand Rapids, Mich.

HEAVY SCREW DRIVERS.

The young mechanic is very apt to ruin one or two good screw drivers in trying to start set screws or screws that have rusted in. For this and similar work a specially heavy screw driver is made, the shank being square and strong. The operator can then put all the power he wishes on the wrench, without fear of twisting it or bending the blade.

HOW TO MAKE A TORCH OF PIPE.

A simple and inexpensive torch may be made of a short length of pipe. Select 1½-inch pipe for the purpose, and on the bottom screw a cast-iron cap, one which is heavy enough to form a base for the torch and hold it upright. Use a malleable iron cap for the top and before screwing it on tap a hole for ½-inch pipe 3 or 4 inches shorter than the body, and the screw-thread should be about 3 inches long on one end. Screw it through the cap from the bottom until it projects about 2½ inches, says the Engineer, and the torch will be complete.

A GOOD SOLDERING FLUID.

A correspondent in Bubier's Popular Electrician gives the following recipe:

Take a piece of scrap zinc or pure spelter, say about ¼ pound, and immerse it in a half-pint of muriatic acid. If the piece completely dissolves, add more zinc until the acid ceases to bubble and a piece of metal remains. Let this stand for a day and then carefully pour off the clear liquid, or filter it through a cone of blotting paper. Add a teaspoonful of sal-ammoniac, and when thoroughly dissolved, the solution is ready for use. Depending on the materials to be soldered, the quantity of sal-ammoniac can be reduced. Its presence makes soldering very easy, but, unless the parts are well heated so as to evaporate the salt, the joints may rust, and a poor electrical connection result. Some concerns put a few drops of glycerine in their soldering fluids.

TAKING OUT BRUISES IN FURNITURE.

If the bruise is very small all that is necessary is to soak it with warm water and apply a red-hot poker near the surface, keeping the spot continually wet until the bruise disappears, which will occur in a few moments.

For larger bruises or dents wet the part with warm water and double a piece of brown paper five or six times, soak it, lay on the bruise, and then apply on top of the wetted paper a hot flatiron until the moisture has all evaporated. Keep this process up until the surface is level.

ANGLING FOR A FOOT-VALVE.

A good tool for fishing up a broken foot-valve in a pump was contrived by a correspondent of Power. An impression of the valve, the construction of which no one knew, was first taken by means of a tomato can filled with bar soak, secured to the pump rod and lowered into the well until the open end of the can of soap rested on the foot-valve. When withdrawn it showed the imprint of a rubber valve tilted up at an angle.

The fishing tool was made of a strong wood screw fastened into the lower socket of the wooden rod by standing the screw on its head on the bottom of the socket and pouring babbitt metal around it, which was hammered down solid to keep the screw from turning. When lowered into the well a few turns of this tool sank the screw into the rubber and the valve was drawn up into view after which a new foot-valve was put on.

REMOVING LIME IN WATER JACKET.

The removal of lime incrustation is always a more or less difficult job. Muriatic acid, of course, cuts the lime and dissolves it, but it is liable to cut quite deep into the iron as well and leave it rusted, says Gas Power. A small amount of common washing soda used in water after you have washed out the acid will neutralize the acid, but you should be careful to wash the water containing the soda out, as soda remaining for any length of time will rust the pipes and connections, too. One of the most efficient methods that I have ever seen for removing scale from small automobile boilers was to use common crude oil mixed in with the water. The process is this: First disconnect your tank and drain all of the water out of the jacket, then pour in about a pint of crude oil in the jacket, then fill in with water until the oil shows at the top outlet of the jacket; shut off the circulation of water and run the engine, carefully watching it so that it does not become overheated. Then engine should be run until practically all the water in jacket boils away. As the water level goes down the oil follows and has a very considerable loosening action on the lime. The advantage of this method is that there is no risk of rusting, but there is some of overheating and the engine should be run at quite low speed in order to avoid this.

LIFE OF CAST-IRON PIPE.

It is extremely difficult to get any satisfactory estimate as to the average length of life of street mains. Practical men in the trade say that it is a question for the chemist, says Domestic Engineering. The chemical constituents of the soil and the likelihood of exposure to electrolysis have everything to do with the matter. Where garbage has been deposited, or the soil is alkaline from any cause, the pipe may not last more than three or four years. In a good natural clay or sandy soil pipes can easily last for twenty-five years. At the City Hall it is said that eighteen years is a fair estimate in Chicago, where conditions are most favorable.

A SIMPLE TEMPERING RECIPE.

Dissolve a small quantity of sal-ammoniac in water, make the metal red hot, dip it in the mixture and leave enough heat in metal to draw it back a bit. If left to cool in the liquid tools will show too hard.

TO REVIVE FROM SUFFOCATION.

By inhalation of poisonous gases, vapors, such as illuminating gas, charcoal vapor, gas in wells, sewer gas, coal gas, mine gas, etc.

Remove the patient to open air and send for a physician.

In rescuing, avoid risks. If in a room, open and close the door rapidly to fan and force air into it; break out windows. Do not take a light into a cellar, mine, well, apartment, or any place where gas has escaped. Tie a rope around the waist of rescurer; cover his mouth and nose with a handkerchief wet with vinegar and water.

Get the patient to fresh air. Dash cold water on his face and chest. Use artificial respiration the same as in drowning. Apply hot bottles to body; put mustard plasters to heart, soles of feet and wrists; when recovering, mild stimulants may be used.

HOW TO MAKE A GRAVEL ROOF.

There is no reason why a gravel roof should not be a good one, if only proper care and good materials are used in its construction; at least it should be good for the money expended on it when compared with the cost of tin, galvanized or copper roofs. Of course, a gravel roof is only suited for a low pitch or flat roof, as on a steep roof the gravel would eventually wash off and leave the paper or canvas exposed to the weather. Ordinary coal tar answers fairly well for a top coat before the gravel is spread on, if the roof is very flat. If the roof has a good pitch it is a good idea to mix 8 or 10 pounds of common rosin with the pitch while it is boiling, stirring the mass well with a stick before it is taken out of the boiler.

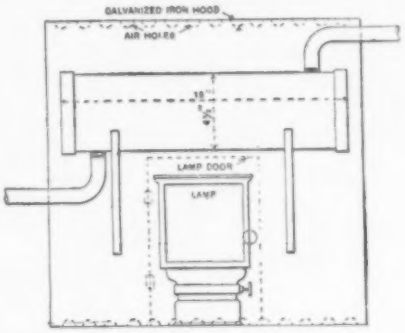
To prepare the roof before covering with tar after it is boarded tightly with matched stuff, the following rules should be observed: In all cases the grain of the roofing boards should run in the direction of the pitch—never across it—and all joints should be driven close and tight. The boards should be planed on the top side, and should be free from shakes or knot holes. Swab the whole roof over with a thick wash of Portland cement mixed with water to the consistency of thick paint. Let the roof dry for a few hours, then lay on a coat of good roofing paper—tarred paper preferred—having a lap of about one-third of the width of the paper. Over this give a thin coat of hot tar, in which ground asbestos, mica or Portland cement has been mixed, in the proportion of one bucketful of cement to four of hot pitch. Let stand until dry and hard. Over this lay another coat of roofing paper, and on this lay a thickness of rough sacking, which must be tacked down here and there with broad-headed tinned nails, such as tinsmiths use in roofing. On this sacking lay a thick coat of the tar while hot, and then sprinkle coarse sand and fine gravel on the hot tar and leave to harden. The tar must contain the proportion of asbestos, mica or cement as described in the foregoing.

Such a roof properly laid will last from seven to nine years, and may then be made good again by a generous coat of tar and fine gravel.

Our readers are urged to contribute to "Shop Notes" any kink they have worked out or may be using to advantage.

HOT WATER FOR BARBER SHOP.

A correspondent in the Metal Worker offers the following as a small heater which any mechanic can fix up. Make a small boiler of a piece of 4-inch wrought iron pipe, 15 inches long, with the ends capped and the inlet and outlets arranged as shown in the sketch. This is designed to lie horizontally and to have ½-inch holes drilled



Plan of Stove and Boiler Arrangement.

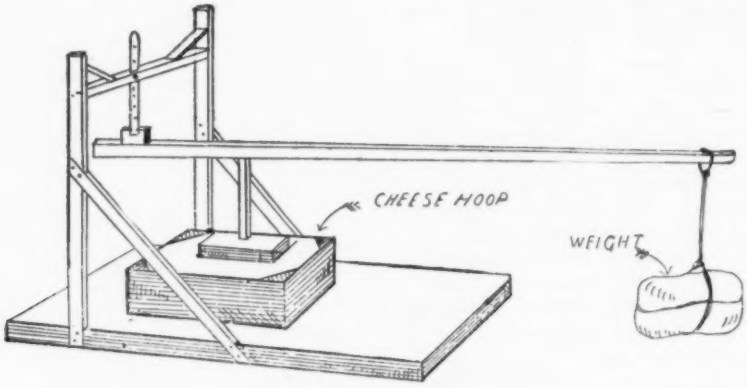
and threaded in each end, one on the top and the other on the bottom. This can be set up on a stand or brackets sufficiently high to allow a one-wick oil stove to be set under it. The stove and heater could be inclosed in a galvanized iron hood, with a few holes in the top and a few in the bottom to let in fresh air and allow the products of combustion to escape. The hood should have an opening large enough to allow the oil stove to be inserted and removed. This may be set under a sink, or any place where it will be out of sight. The space adjoining it may be protected by asbestos paper, if deemed necessary. If there is gas in the building, a gas flame can take the place of the oil stove.

HOW TO DARKEN OAK.

Oak may be immediately and easily darkened by laying on liquid ammonia evenly with a rag or brush. The effect produced is just the same as is produced naturally by age and the color will not fade. Bichromate of potash, dissolved in cold water and applied with a brush, is another method of deepening the color, or new oak may be brought to any shade, or nearly black, by the application of a decoction of green walnut shells. Be careful to apply each coat evenly.

HOW TO MAKE A CHEESE PRESS.

A cheese press may very easily be made at home and the skim milk used for making the cheese. If it has been the custom to feed skim milk to the hogs, the warm fresh whey may be given them instead, says Hoard's Diaryman.

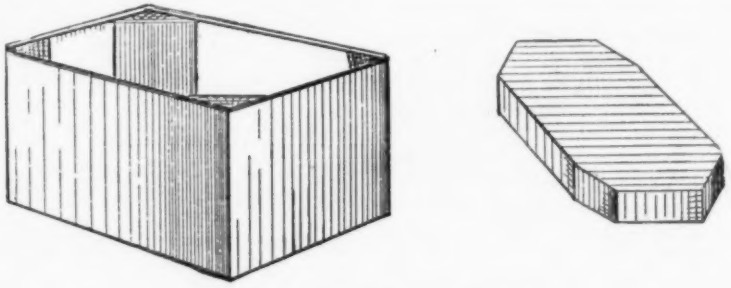


Home-Made Cheese Press

Make the bottom pieces of the press of wide plank and the standards of 2 x 4-inch wood—any wood that is tough and strong will do. The crosspiece between the standards should be very strong, also, so that it will bear the leverage. The part with the holes in should be of iron and adjusted by an iron pin. Weight the lever with a large stone.

Make the octagon-shaped cheese mould or hoop of inch boards, triangular shaped pieces being used to form the corners. The follower should be sawed from 2-inch plank to fit the hoop; make it deep and narrow so that the cheese may be pressed out in a good shape. The cheese hoop with its follower is placed on the bottom plank of the press and a square block of wood in which a short post is inserted is placed over the follower and makes the fulcrum for the lever.

In making cheese all milk containing from one to two per cent fat may be used. Besides the press a dairy thermometer, rennet, coloring and cheese cloth will be required. One hundred pounds of skim milk will make 7 or 7½ pounds of cheese. Fill the boiler with milk and place on the stove. Put the thermometer in the milk and slowly heat to 86 degrees. Now add two teaspoonfuls of rennet extract with water, about a half cupful, before adding to the milk. At the same time add a teaspoonful of coloring. Let the milk come to 90 degrees, take off the stove and cover with a cloth; in 15 or 20 minutes it should be sufficiently coagulated. When so, lift on the stove again, and with a table knife cut the curd in all directions so as to divide it into small cubes; heat slowly to 100 degrees, stirring occasionally to prevent the curd settling to the bottom and burning or over-heating. When a handful of curd upon being tightly squeezed until all the whey is out will fall apart easily, it is cooked



Octagon Cheese Hoop and Follower

enough. Take it off the stove again, cover as before and allow the curd to lie in the whey for a time. Lift the curd into a sink and let it drain. Work out the whey, grind the curd up with the hands, salt it with about 6 ounces of salt per 100 pounds of milk and work well. If not enough curd to fill the mould keep it in a temperature of about 60 degrees until next day, when more curd may be added.

After being in the press two hours, the cheese should be turned upside down, the cloths fixed nicely, and the pressure added as before; leave in press for two days; have the cheese well bandaged when put away to cure. A temperature of 60 to 70 degrees is best for curing the cheese, where it should be kept for three weeks, and turned daily.

HOW TO MAKE PHOSPHOR TIN.

The method for making phosphor tin which I use may not be applicable in a brass foundry doing a large business, but it is worth knowing, says a correspondent in the Foundry. This method must not be confounded with the fireworks producing method of using yellow phosphorus, with or without a coating of copper sulphate. I use red phosphorus, which can be obtained in the form of powder. It will not ignite below a temperature of 240 degrees Centigrade. The melting point of tin is about 230 degrees Centigrade, or ten degrees less than the ignition point of red phosphorus, and it is this difference of ten degrees which makes the method possible.

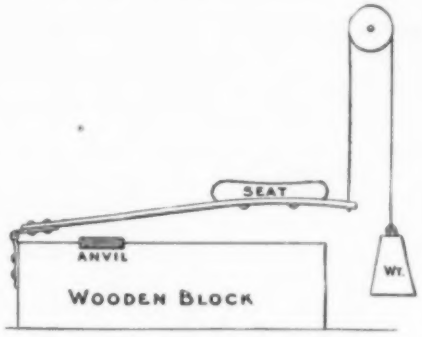
For every 28 pounds of tin, take 4 ounces of phosphorus and ram fairly hard into the bottom of a crucible of sufficient size to receive the required quantity of tin. The phosphorus should be covered with powdered charcoal and the crucible warmed before puting the phosphorus in. Melt the tin in another crucible, bearing in mind the fact that it must be just melted and not overheated, on account of the fact that there is only a ten degree leeway between the melting point of the tin and the ignition point of the phosphorus. Pour the tin into the crucible containing the phosphorus, and after stirring and allowing some time for mixing, place the crucible in the furnace and burn off the excess of phosphorus. Arsenic tin can be made in the same way.

All the articles in "Shop Notes" department are printed at end of year in book form. Price 50 cents.

HUMAN CLAMPS.

In the shops of the Pennsylvania lines at Pittsburg, Pa., a very ingenious clamp is used in dismounting broken air and steam hose, says Railway and Locomotive Engineering. The clamp is quite as practical as it is curious, however, and might readily be adapted to other forms of work.

It consists of a stout block of wood about 16 inches high placed on the ground and having an iron plate let into its upper side at a suitable point. The plate forms a sort of anvil. A piece of spring steel is hinged at one end of the block and the other end of the steel carries a seat, the whole being counterbalanced by a weight which hangs from a pulley on a post nearby.



Seat Clamp For Dismantling Hose

When the operator wishes to take off broken hose from a nipple which is to be used again, he lays it on the anvil, leaving the clevis projecting beyond the steel spring, and then he literally sits down on the whole job. His weight effectually clamps the piece of hose pipe in place, and holds it in a most convenient position for working. When he wishes to release the work, he eases up on his seat, and the counter weight on the post carries seat and spring up so that the hose is instantly freed. In fact, the act of standing up to reach another broken piece of hose lets the one which has been dismantled come out of the machine.

The device is very simple and as there is practically nothing about it to wear out, it has no maintenance charge. The heaviest man secures the best clamp on his work.

If Popular Mechanics has no representative in your shop write for particulars, and learn how you can earn money easily every month.

HOW TO MAKE A HANDY KEY-SEATING TOOL.

A correspondent of the American Machinist tells how he made a key-seating tool and 12 keyways in one and one-half hours. He says:

"The problem was to keyseat some gunmetal articles, and as the hole was ⅜ inch

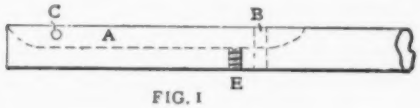


FIG. 1

FIG. 2

A Keyseating Tool

diameter by 2 inches long, I thought it impracticable to chip or file them—the more so, as they had to slide on the shaft without much shake. This necessitated a smooth, straight keyway.

"I took a piece of ⅜-inch shaft about 12 inches long, milled a keyway (A) in it about 3 inches long, and inserted a tool shipped like Fig. 2. B is a ⅛-inch pin for a stop to take up thrust, C is a 1-16 pin holding tool in slot, D is the cutting edge.

"I then held the articles in the universal chuck of the lathe, the tool mounted in the tool-post of the lathe. I then pushed through, tightening ⅛-inch screw (E) each cut. The tool and twelve keyways complete took one and one-half hours."

HOW TO RECOGNIZE A GOOD QUALITY OF GLUE.

Break a cake of the glue into several pieces, either by striking it a blow with a hammer or by bending it. If the broken pieces have smooth, even edges, the glue is of poor quality. If the edges are very ragged, the quality is good. The more splinters at the broken edges the more the glue is to be depended upon and it will stand damp weather well.

A German chemist has invented a method of manufacturing fluid gas from the residuum of petroleum and heavy mineral oils. The inventor claims it can be manufactured cheaply where there is an abundance of petroleum and can be transported in cylinders. The gas makes a brilliant light for street lighting and is very difficult to explode.

PUTTING PLUGS IN WATER PIPES.

While making some changes in the water piping in a large building I ran across a job that I think worthy of mention, says a writer in Practical Engineer. The business of the company occupying the building necessitated the erection of a new building in the rear of the main building, and when the contractor was well along with the excavating work it was found that the city water pipes were much in the way, so much so that it was necessary to break and plug several joints.

I found that to do this would require four 8-inch plugs and two 10-inch plugs. As the piping was cast iron and the joints bell and spigot, considerable time was lost looking for special plugs. Only two plugs could be found, so I made the following suggestion: I had two blank flanges cut from 3-16-inch boiler plate the same diameter as the spigot end of the pipe, two 8-inch and two 10-inch. After hunting around the plant I found two specials, the running size being 8 inches and the side outlets 4 inches, which were broken at the 8-inch bell ends. Using a handle chisel, the spigot ends were cut off; the ends were 14 inches long. For the two 10-inch openings I had to cut the spigot end off of two lengths of 10-inch cast iron pipe. Making sure that the blank flanges were smooth, I put them into the bell of each opening and with the spigot end against that, and wedged the pipe firmly in the center of the bell, and then drove in about five strands of thoroughly twisted jute. After all the joints had been prepared in this manner I heated the lead and with a jointer on each connection the hot metal was poured in. When the metal had set it was driven up in each joint, and when the pressure was turned on the piping showed no signs of leaking.

REMOVING GLASS STOPPERS.

Glass stoppers sometimes occasion even more difficulty than corks in their removal. An almost infallible cure for a fixed stopper is to grasp the bottle in the left hand, and with the thumb press against the offending stopper, while with the right hand gently tap against this pressure, using the handle of a knife or other hard instrument. In this way gradually work round the stopper, which will quickly become loose enough to be extracted.

EMERGENCY ROPE TIRE FOR AUTOMOBILES.

Rubber tires are not always to be had when wanted, but a piece of rope is generally to be found at any farm house. The Automobile gives the following valuable instructions on making an emergency tire:

If a tire is injured on a run so that it cannot be repaired, and if a substitute is not available, a rope can be wound on the wheel rim and the car run slowly to the nearest repair station. Before applying the rope, the car must be jacked up and the tube and shoe removed from the rim. The clamps or lugs which help to hold the shoe in place are also removed. Procure a piece of rope, of such diameter that when wound on the rim it will project above the edge or clincher and thus protect it. The rope should be long enough to wind around the rim several times, so as to completely fill the space in the rim ordinarily occupied by the tire.

Before the rope is put on, a piece of wire or strong cord should be fastened securely to one end. The free end of this cord or wire is pushed through the valve hole in the rim and fastened to one of the spokes. After one of its ends is thus secured, the rope can be wound on the rim. Care should be taken that the rope is wound on as tightly as possible. To do this an assistant will be, usually, required, who should turn the wheel slowly while the rope is laid on under tension. The other end of the rope is now secured by means of a piece of wire or cord, passing through one of the clamp holes and fastened to a spoke, as already directed.

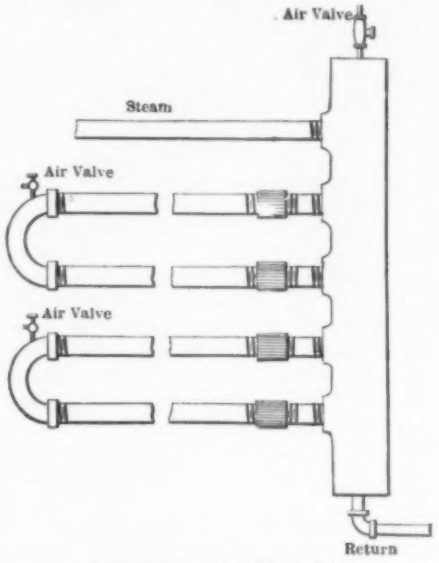
After the car has been lowered down and the jack taken away, the motor may be started and the car driven slowly to the nearest repair station. When driving a car having ropes on a wheel rim as described, great care is necessary. When passing over car or railroad tracks, or when passing over streets paved with stone blocks, the rim may be ruined, if the car is driven at any but the slowest speeds.

It is well to bear in mind that the wheel which has the rope on its rim has a smaller effective diameter than the other wheels, which have tires on. Consequently if either of the rear wheels are roped as described, the differential gear will function as long as the car is moving. For this reason the car should not be driven any great distance under these conditions, as excessive wear of the differential pinions would result.

Ropes on one of the front wheels will interfere with the operation of the car only very slightly, and it may therefore be driven for a greater distance without injury than if one of the rear wheels is roped. If there are any passengers it is well to arrange them so as to have as little weight on the disabled wheel as possible.

RE-ARRANGING HEATING COILS.

A steam heating coil consisting of a continuous coil of pipe around one side and on the end of a room, connected by return bends, which required 15 pounds of pressure to heat was changed by a correspondent of Power, who wished to use exhaust steam for heating so that the room could be heated nicely with less than two pounds back pressure on the exhaust.



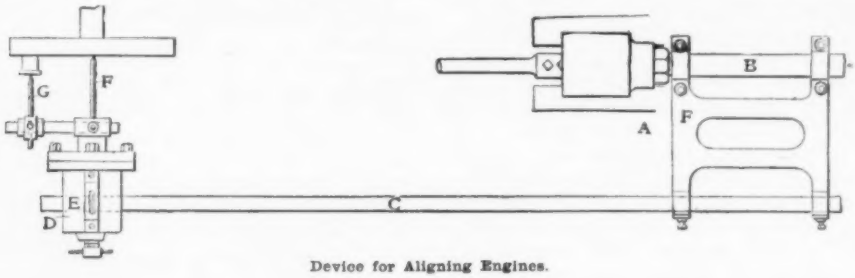
Re-Arrangement of Steam Coils

One day after the coils had frozen up he broke the return bends off at one end with a hammer and substituted a branch tee with right and left nipples and couplings to connect up as shown in the sketch. He put an air valve on the top of the tee and one on the end of each loop. The heat could then be controlled in each loop separately by means of the air valve on that loop, and the whole arrangement worked admirably.

Engineers are scarce in the United States navy and Rear Admiral Charles W. Rae, engineer-in-chief of the bureau of steam engineering, is urging special legislation by Congress with a view to increasing the number of naval officers available for engineering duties.

A SIMPLE INSTRUMENT FOR ALIGNING ENGINES.

An instrument for aligning engines which is simple in construction and particularly helpful in engine-rooms containing a number of engines on which adjustments are frequently made is described by a correspondent of Power who says he patented it years ago.



Device for Aligning Engines.

It consists of a frame, A (see sketch), which is attached to the piston rod of the engine, B, after the connecting rod has been disconnected from the crank-pin. The rod, or preferably a tube, C, is adjusted in the frame, A, and is perfectly parallel to the piston rod, B. This rod, which lies in the same horizontal plane as the piston rod, extends a few inches beyond the center of the crankshaft, forming what is a parallel extension of the piston rod, A. On the end of the rod, C, is carried the sliding adjustable head, D, which is fitted with a small level on the top, E, and two adjustable pointers, F, and G; F is centered at the center of the crank-shaft and G at the center of the crank-pin, and if the crank-shaft is true when it is rotated, the ends of these pointers will remain at the same parallel distance from the rod, C. If the shaft is not at right angles to the piston rod, on rotating it and the pointer, G, the error may be easily measured by observing the amount that the pointer, G, slides in or out of its socket in order to remain in contact with the end of the crank-pin. The slightest variation of the shaft from a right angle or a level position will be shown by the instrument, which may be used without a great amount of labor or loss of time.

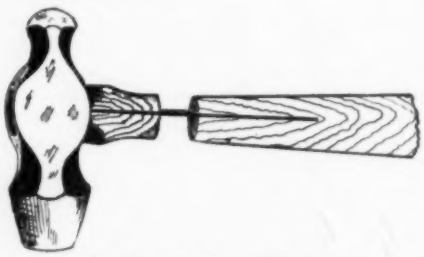
BULGING PUTTY.

In a paper read before the Master Car and Locomotive Painters, at Atlantic City, B. E. Miller reported:

"Bulging of putty is probably caused by the expansion and contraction of the wood during damp weather. As the moisture is evaporated the surface shrinks, decreasing the size of the nail hole. Ninety per cent of the effect is from this cause and 10 per cent is from the expansion and contraction of the nail and the effort of the wood fiber to straighten. It was demonstrated to the committee that where a small nail was used the bulging amounted to but little. The bulging increased with the size of the nail head and the depth of set. It was recommended to use none but seasoned lumber; use small-headed nails as possible; set them not more than 1-16 of an inch below the surface; thoroughly prime and second coat all depressions, including heads of nails and screws."

IMPROVING A HAMMER HANDLE.

When putting a new handle in a hammer for use at the anvil the following little wrinkle, given by a correspondent of the American Blacksmith will be found to greatly improve it.



An Improved Hammer Handle.

Cut a ¾-inch piece out of the handle 2 inches from the hammer head. Slot each end of the cut to receive a piece of spring steel 3/32-inch thick and as wide as the handle. Fasten the steel with rivets. The extra work requires but a few minutes longer, and well pays for the trouble.

THAWING SERVICE PIPES BY ELECTRICITY.

A Transformer Specially For This Work

The approved, rapid and economical method of thawing frozen water and gas pipes is by electricity. A new transformer for this especial purpose and designed to work on alternating circuits of from 2,000 to 2,300 volts, is the latest addition to the electrical apparatus. The transformer operates by means of an adjustable core or flux shunt controlled by a hand wheel and locking device.

The transformer after being located close to the frozen pipe should have the flux shunt core dropped to its lowest position, the secondary connected to the water pipe and the primary connected to the line. After closing the primary switch the shunt should be raised by means of the operating handle until a sufficient voltage and current are obtained for the particular pipe under treatment. The operating handle should then be securely clamped by means of thumb screws provided for this purpose. After the pipe is completely thawed, the shunt should again be secured at its lowest position ready for the next treatment. In thawing street mains two adjoining hydrants can conveniently be used as terminals. Service pipes can be thawed out by using as terminals a house faucet and the nearest hydrant, the house faucet and the service pipe, or a faucet in a neighboring house.

In every case special precaution must be taken to make good connections, otherwise the water faucets, hydrants, pipes, etc., used for terminals will be burned and disfigured by the heavy current used.

No positive rule is given as to the exact length of time required in any particular case owing to the widely varying conditions, but the following table compiled from records made last winter furnish a fair basis of average conditions:

Size Pipe	Length	Volts	Amps.	Time Required to Thaw
¾"	40 ft.	50	300	8 min
¾"	100 "	55	135	10 "
¾"	250 "	50	400	20 "
1"	250 "	50	500	20 "
1"	700 "	55	175	5 hrs.
4"	1300 "	55	260	3 "
10"	800 "	70	400	2 "

The manager of the Public Service Corporation of New Jersey, which has a record of 2,963 services thawed out, states: "The first wagon was fitted up with a considerable amount of apparatus for making calculations, but after a very brief experience all the instruments were discarded and the operator simply gauged his work by the manner in which the water boiled in the barrel on the wagon, which was used as a resistance. Additional wagons were fitted up in this manner and the work carried on

Transformer For Thawing Out Pipes

to the extent of our ability to spare men and wagons from other work. Most of the wagons contained a 300-light transformer wired up to a rough wooden rack, with primary fuse boxes on the side, and sufficent length of wire to reach an ordinary overhead circuit, the custom being to stand the wagon alongside the pole nearest the building where the pipes were to be thawed out. On the secondary side a heavy knife switch properly fused was fastened in the bottom of the wagon, and two coils of heavy wire mounted on reels were also provided.

"In the case of a single building, the method of procedure was usually to connect the primary leads to the overhead circuit, insert the primary fuses, run out the two heavy wires from the reels to the desired

length; one end being connected usually through the cellar window to the water pipe, as near the cellar wall as possible, the other end being connected to the nearest hydrant or curb box, preferably on the opposite side of the street. The object was to allow treatment of the pipe at any point between the cellar wall and the street main, as there was no way of determining the exact point of interruption.

"When the pipes of two or more adjacent buildings were to be treated, the water services were simply connected in series, and as a matter of fact it was found to be just as easy to thaw several houses and took no more time than it did for one. As a matter of experiment we tried grouping buildings, to see what the result would be, and the largest number we were able to find in one location, which consisted of a row of small tenements, fourteen in number, were thawed out as easily as a smaller number, although the time required was somewhat longer.

"By having sufficiently long secondary leads, we also found it more convenient to extend the secondary than to move the wagon, and in one instance we thawed out about thirty pipes without moving the wagon. The length of wire used in this case, however, was about 500 feet. Charges for the service varied from $4 to $15, and was very much less than the cost of tearing up the pavement would have been. In one case a 6-inch main was thawed out simply as a matter of experiment, the time required being about three hours. The number of services that can be handled by one outfit in a day depends entirely on local conditions of poles, wires and location of service. Our outfits consist of two men each with a horse and wagon, and each outfit averages all the way from 10 to 200 pipes thawed out per working day."

Transformers are also made to work on circuits of 500 volts.

COVERING FOR OVERHEAD STEAM PIPES.

A pipe for overhead steam pipes that is advocated by Mr. Robert Watt in a contribution to the question box of the Ohio Gas Light Association is described in the "American Gas Light Journal." The pipe is enclosed within a molded covering and wrapped in canvas, and the canvas is painted with two coats of tar boiled down to the consistency of soft pitch, having a little slate flour, slaked lime or hydraulic cement added to it. It is applied with a brush, the second coat two or three days after the first.

CLEANING BOILER TUBES.

In a certain city there are two breweries operated by one company each brewery having a separate steam plant says a correspondent in the National Engineer. The engineer of one of the plants insists that the proper way to keep his boiler tubes clean is to use a steam cleaner frequently and not use a scraper until the boiler is laid off, or, in this case, about every two weeks. In defense of this method he states that the boiler and inner setting are exposed to the surrounding atmosphere for a much shorter period of time than would be possible if a scraper alone were employed.

At the other plant the tubes are scraped each day, the engineer there claiming that using a steam cleaner serves to accumulate soot in the tubes, whereas the scraper effectually removes it.

In my opinion both methods are right under certain conditions. One objection to the steam cleaning method, as found in average use, is that the steam used is heavily saturated with water, and in passing through the tube part of it condenses, causing an immediate pasty deposit in the tube, which shortly after hardens and perceptibly affects the transfer of heat to the water in the boiler. In such cases, unless a scraper is used frequently, this deposit accumulates to an extent that calls for a considerable amount of coal in excess of what would otherwise be necessary. Just how often the scraper should be used depends somewhat on the conditions the boiler is operated under. It is safe to say, however, that reliance should not be placed exclusively on steam cleaners. If it comes to a choice between the two methods, the scraper will be found to keep the tubes cleaner than the steam blower.

More natural gas was produced last year than ever before, and was valued at $35,815,000. Ninety-four per cent was produced in Pennsylvania, West Virginia, Ohio and Indiana. The consumers, manufacturers and individuals totaled 634,269. The United States produced 99 1-3 per cent of the entire world's production of natural gas.

LARGEST STEEL-CONCRETE CHIMNEY IN THE WORLD.

The largest steel-concrete chimney in the world was recently erected at Bellevue, Mich. It is about 182 feet high with a 22-

Concrete Stack

foot square base built in solid rock 4 feet in the ground, and having 108 steel bars imbedded in it. The chimney consists of an inner and outer shell, 8 and 4 inches thick, respectively, to a height of 60 feet, where they join, tapering from there on from 8 to 5 inches in thickness. It is a single piece from top to bottom and weighs with its base, 390 tons, 25,000 pounds of which is steel. Work was carried on from the inside at the rate of six feet per day.

TO LOOSEN RUSTY SCREW.

One of the simplest and readiest ways of loosening a rusted screw is simply to apply heat to the head of the screw. A small bar or rod of iron, flat at the end, if reddened in the fire and applied for two or three minutes to the head of a rusty screw, will, as soon as it heats the screw, render its withdrawal as easy with the screwdriver as if it were only a recently inserted screw. This is not particularly novel, but is worth knowing.

HOW TO SOFTEN PUTTY.

Putty which has become hardened by exposure, as around window sash, may be softened and readily removed by the use of the following mixture:

Slake three pounds of quickstone lime in water and add one pound of pearlash, making the whole of about the consistency of paint. Apply to both sides the glass and let it remain for 12 hours. At the end of that time the putty will be sufficiently soft so the glass can be lifted out of the frame.

HOW TO CLEAN POLISHED WOOD.

An encaustic composed of wax, sal soda and a good soap is excellent for cleaning and polishing at the same time. Shave the wax and the soap and dissolve them in boiling water; stir frequently and add the soda. When the wax and soap are thoroughly dissolved place the mixture in a vessel which can be closely covered and stir constantly till cool.

This mixture will remove ink from polished surfaces and may be satisfactorily applied to marbles, bricks, furniture, tiles and floors.

A car door fell from a freight train on the Southern Ry. so that it rested on both rails. The locomotive of a passenger struck it and the locomotive and tender were thrown down an embankment, killing the engineer, fireman and a flagman.

WORN VALVE GEAR AND HOW TO DEAL WITH IT.

Faulty action of the exhaust valves due to wear in the valve actuating mechanism is the cause ascribed by the Automobile of motors missing and not giving off power. In an excellent article on worn valve gear that paper further states:

The rollers, or shoes, which ride on the cams of the half-time shaft or the cams themselves may wear, owing to defective lubrication, or to the material of which they are made being too soft. If the amount of wear is, say, one-eighth of an inch, it is clear that the valve will open just this much too late, and close this much too early.

Back pressure will be caused by late opening, particularly at high speeds, and the burned gases will be retained in the cylinder by early closing, and will be compressed toward the end of the exhaust stroke. When the inlet valve opens, therefore, these burned gases, which are then under pressure, will rush out into the inlet pipe, and displace a portion of the incoming charge. Now the piston goes out on the suction stroke, and as the inlet pipe is full of exhaust gas, the fresh gas will not reach the cylinder until the piston has moved out a considerable percentage of its stroke. Consequently the volume of the aspirated charge will be less, and the percentage of burned gas to fresh, or explosive, gas will be greater. This will cause weak explosions and loss of power.

A little consideration will show that if the exhaust valves act as described, it will be almost impossible to throttle the motor, so as to make it run slowly. When the motor is throttled very much only a small quantity of explosive gas is taken in during each suction stroke. There is, as just shown, a relatively large volume of burned gas in the cylinder and passages. This burned gas may dilute the fresh gas to such an extent as to render the resulting mixture non-explosive.

When there is a greater distance between the "push-rod" and valve stem than 1-16 inch the valve actuating gear should be taken apart and refitted. More clearance must be allowed between the rod and valve stem when the latter is long than when it is short. The reason is, that a long valve stem lengthens more on being heated than a short stem. For this reason before testing the clearance between the stems and rods, one should make sure that the motor is thoroughly heated by running it for ten or fifteen minutes. This run ought to get the valve stems up to working temperature.

When fitting a new exhaust valve—especially if it has a long stem, and everything cold—be careful not to make this clearance too little. If too little clearance is allowed when the parts are cold, the expansion due to the working heat may be sufficient to lengthen the valve stem so much that it will rest on the end of the push rod, and so prevent the valve from seating fully. This will, of course, result in great loss of power also.

Often a motor will have good compression when cold, or slightly heated, and have next to none at all after it has run for some time. When a motor acts in this way, the trouble is usually due to leakage past the valves on account of the small amount of clearance between the valve stems and the push-rods. When the stems and valves are cold, the latter seat properly, but when the stems are heated, and of course expanded, the valves are prevented from seating by the stems resting on the push-rods.

Valve seats which are pitted badly are usually faced off. So much metal may be taken off in doing this that the stem of the valve—when the latter rests on the re-made valve—will touch the push-rod. After valves have been ground in a great deal, or after they have been faced off, the stems may also strike the push-rods. The action of mechanically operated inlet valves will be affected by wear in the mechanism, the same as exhaust valves.

Inasmuch as the springs on the inlet valves are usually weaker than on the exhaust valves, the wear on the parts which move them will not be so great. Another reason why the wear is less is that there is no pressure on the inlet valves at the instant when they are lifted, while the exhaust valves may have forty or more pounds pressure to the square inch on them at this moment.

Inlet valves do not get nearly as hot, and consequently do not expand as much as exhaust valves. For this reason less clearance should be allowed between the stems and push-rods than would be allowed between the stems and push-rods of exhaust valves.

The remarks about facing off the seats of valves and grinding in of exhaust valves apply to inlet valves also.

ELECTROGRAPHY: A COMPANION TO PHOTOGRAPHY.

[Excerpts from an article in London Technics, by Prof Chas. R. Darling, Demonstrator in Electrical Engineering Guilds Technical College, Finsbury.]

The term "electrography" is intended to embrace all the methods whereby, on passing a current of electricity through a suitable medium, images of the anode or kathode may be obtained either directly or by "development." The name was suggested by the analogies to photography presented by the processes, the difference consisting in the use of electricity instead of light to produce the effects.

A simple and convenient method of procuring these images or "electrographs" is by the use of the apparatus illustrated in Fig. 1. It consists of a sheet of metal A (preferably zinc or copper), on the top of which is placed an impression-pad B, consisting of a few sheets of damp blotting-paper superposed. The medium in which the images are to be obtained consists of a sheet of ordinary white paper C, damped with water or a suitable solution, according to the effect desired, as will be described later. One terminal of a battery is connected with the zinc plate, the other terminal being pressed on a metallic substance D (which may suitably consist of a coin, or small metallic block as used by printers), thereby completing the circuit through the pad and paper. Good results may be obtained by using a battery of six small accumulators,

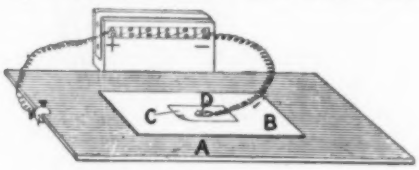


FIG. 1.
APPARATUS FOR OBTAINING ELECTROGRAPHS.

or six bichromate cells in series; whilst for quicker results wires from 100 volt mains (direct current) may be used. If arranged as shown in the figure, the coin being connected to the negative end of the battery, the direction of the current will be from the plate A (anode), to the coin D (kathode), through the pad and sheet of paper; to use the coin as anode it is only necessary to reverse the connections.

If, now, the sheet of paper C has been prepared by soaking in water and pressing out the superfluous moisture between the folds of blotting-paper—the pad having been similarly prepared—and a current of electricity be passed by pressing the negative terminal on the coin D for a few seconds, it will be found, on raising the coin, that no visible effect, other than that due to mechanical impression, is observable on the paper beneath. But if now the paper be

FIG. 2.—ELECTROGRAPHS OF COINS. THE LETTERING AND PATTERN ARE REVERSED, FORMING A "NEGATIVE."

treated in turn with silver nitrate solution and hydro-quinone, a clear black image of the coin is obtained. Any photographic developer other than hydro-quinone will produce the effect, and may be applied either before or after the treatment with silver nitrate. Nor is it necessary to "develop" the image immediately after performing the experiment; the paper may be kept for months, and will still be found capable of yielding the picture of the coin. This method of producing a picture differs from photography in so far as the paper is sensitised after exposure to electricity, instead of before exposure, as in photography. Fig. 2 is a reproduction of electrographs obtained in this manner. The lettering on the coins is, of course, reversed in the electrograph; but by employing a fusible metal mould of the coin as kathode, the ordinary appearance is presented.

It cannot be said that any completely satisfactory explanation of the electrical latent image has yet been given.

MECHANICS FOR YOUNG AMERICA

HOW TO MAKE "ANTIQUE" CLOCKS FROM UP-TO-DATE MATERIALS.

Ten years ago the antique clock was the only kind wanted, and it was of no value unless there were evidences of cobwebs and ages about it. The genuine old-timer

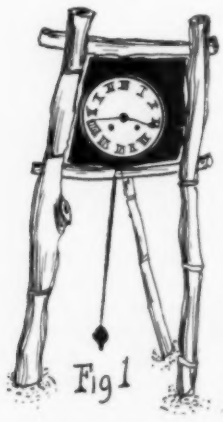


Fig 1

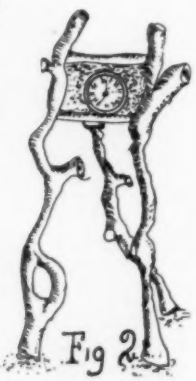


Fig 2

was the only kind desired. There were men in the junk business and men in the antique furniture business who made a specialty of buying the old clocks from the remote farming districts, or wherever any one had an old clock for sale. The clocks of our great grandfathers were in demand at good and remunerative prices to the original owners. Many were loth to part with the heirlooms, but the dazzling prices offered caused many of the people to sacrifice the timepieces. These good old days passed away some years since, and today the modern wood-worker and cabinet-maker supplies the deficiency by putting on the market some home-made, up-to-date forms of "antique" clocks that are far cheaper, more attractive and useful than the old styles.

The first innovation occurred when the antique furniture men began employing cabinet-makers to manufacture fraudulent old clocks. Men who could produce imitations closely, and then apply the proper stains for making the materials appear aged, were in request. These men manufactured numbers of the "copy" clocks, and for a time the sale was active. Then people suspected the genuineness of the undersold clocks, and discovered the fraud. The papers published articles about the fraudulant antiques, and the people no longer were deceived. But the advent of these "built-up" antiques, or "made-to-order" antiques, led to the manufacture of the rustic wooden clocks we are about to describe. The makers of clocks and novel effects in furniture began to produce clocks entirely new, and sold as new, but constructed on the lines of the old-fashioned corner piece of the farmhouse of a century ago. These clocks sold wonderfully well at good prices to the makers, and the demand commenced.

The cheapest and simplest constructed clocks are of the pine and rustic woods order, in which a framework is erected, a base or foundation for the clock fixed thereon, and the affair finished. Clocks of this order can be turned out at ridiculously low prices. Some sell for little over a dollar each, aside from the cost of the clock. The clock proper is usually a separate portion,

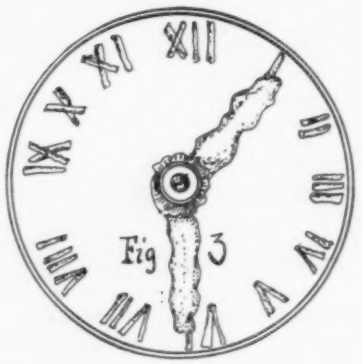


Fig 3

Fig 4

often not fixed to the framework until the entire combination is sold. Some of the unfinished pine clock frames are unique and rustic and appropriate for use in the summer homes. Figure 1 is a sketch of one of the cheaper forms of clocks of this style.

in which the framework is made from sections of bamboo, the joints being made with pins and wiring. The bamboo surfaces are merely rubbed with polishing compositions until a gloss is obtained. When well treated, the gloss retains its glaze and finish for a long time.

The manufacturer of the clock of this description usually makes a number of the rustic frames at the same time, say a dozen. These he erects and then places his order with a clock-maker for the clock faces, works and hands. The pendulums are likewise supplied by the clock-maker. The maker of the wooden clock portion knows little concerning the mechanism of the metallic parts of the clock, and therefore he obtains the clocks in running order and prepared for placing in position in the clock frame. Figure 2 is one of the rustic styles frequently seen in the clock-maker's works for service on porches, or for the house, if so desired. These clocks are made with frames constructed entirely from woods with the bark still on, and the effect is very pleasing. Goodly numbers of this pattern sell. The values run low, and for two or three dollars, counting expense of frame only, a very good outfit can be secured. The cost of the clock, of course, varies with what is desired. Dollar clocks may be fixed in the frame without pendulums and a good effect obtained.

When people purchase the big corner clocks for the hallway or the studio, they like to have something special in the line of faces and hands. Figure 3 is a sketch of one selection. The faces of the clocks are usually decorated in some way and are specially designed for the service they are intended for. The hands likewise are often mounted or ornamented.

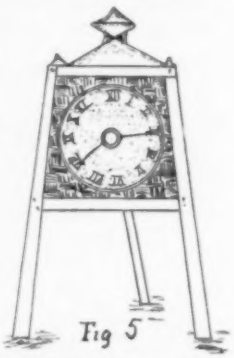


Fig 5

The crown work of the modern antique design in clocks forms another feature of interest. The crowns, as a rule, are separate portions, and since the opening of the "new" old clock industry in the country one is able to find men who make a specialty of the different parts of the clocks. In one city where there were several "old clock" manufacturers and designers one man is devoting his energies and ingenuity

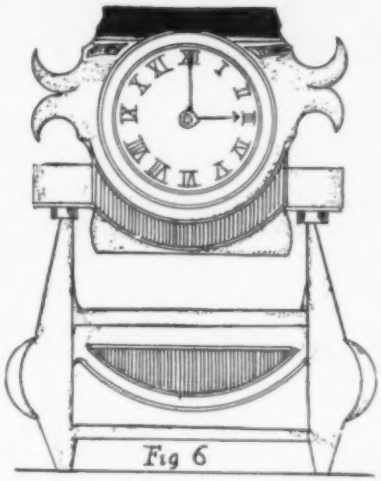


Fig 6

to the designing of clock crowns. Figure 4 is a drawing of one of his crowns. He makes only the crown portion, and this is for fitting over the top of the clock disk, and attached to the clock base. The crown usually has in it some artistic wood engraving and is otherwise decorated to assist in developing the idea of the artist.

The modern maker of the antique clock is capable of grinding out clocks for the chimney corner at rates astonishingly low, providing the customer furnishes the clock proper for insertion in the wood work. On the other hand, if one desires elaborateness, he may get it to the extent of his purse. If he desires to have his clock rendered "old" by treating with chemicals that age the woods and deceive people, he may have it done at a cost of a few dollars. It is pleasing to relate, however, that nearly every old clock-maker states that as a rule the buyers purchase the clocks simply because of their novel appearance, and intend to ornament their homes as such, without any intent at making their guests believe that the clock is an "antique" with a "history." One of the clocks of the more expensive order is shown in Fig. 5.

During the past few years the "old" clock-makers have had demands from advertisers for the service of imitation clocks for placing in railway stations, hotel offices, etc., to advertise products of big firms. The advertising wood clock is usually built up on elaborate lines, as suggested in Fig. 6, and the advertising material is marked thereupon. The advertising is usually made in plain letters. Some of these clocks are being made up to use in

connection with the penny-in-the-slot machines. The clocks can be made to look well and attractive for any place, and as they are usually freely ornamented, they are really part of the furnishings.

One of the best lines of patronage these manufacturers have is from the raffling off of goods at the church fairs, in stores and other places. Often there is a system of "guessing" of numbers and the right number wins, etc. The clocks are conspicuous, and can be liberally advertised in a store or other place where it is desired that the raffle take place. In some of the cabinet-makers' places men are employed at odd times on this line of work. Whenever regular work runs slow, the extra time is converted into money by making the clocks and a considerable profit is derived from the work.

LETTERING A CLOCK DIAL.

Painting Roman characters on a clock dial is not such a difficult task as might at first be imagined. In fact, if one has a set of drawing instruments and properly proportions the letters, it is really very simple.

The letters should be proportioned as follows: The breadth of an "I" and a space should equal one-half the breadth of an "X," that is, if the "X" is one-half inch broad, the "I" will be three-sixteenths inch broad and the space between letters one-sixteenth inch, thus making the "I" plus one space equal to one-quarter inch or half the breadth of an "X." The "V's" should be the same breadth as the "X's." After the letters have been laid off in pencil, outline them with a ruling pen and fill in with a small camel's hair brush, using gloss black paint thinned to the proper consistency to work well in the ruling pen. Using the ruling pen to outline the letters gives sharp straight edges which would be impossible with a brush in the hands of an inexperienced person.—Contributed by S. L. Hatfield, Wagoner, Ind. Ter.

FOCUSING SCREENS.

To make a focusing screen, superior to the finest that can be bought, fix a dry plate, then flood it with a 10 per cent solution of chlorid of barium, and follow this with a 10 per cent solution of chlorid of magnesium. Allow to dry, and a perfect focusing screen results, says Photo-Beacon.

HOW A BOY BUILT A STEAM ENGINE WITH FEW TOOLS.

A boy who possesses natural mechanical and inventive genius can build himself a steam engine even though he does not have access to a small machine shop and though his materials be crude. Howard Burr of Leon, O., built for himself a one-half horsepower engine which will operate a sewing machine. He cut his own patterns, then molded the various parts in sand. The castings were made of babbitt metal, which he heated in a ladle in a cook stove. The engine works perfectly. It is shown in the

Howard Burr and His Engine

photograph together with its inventor.

In response to our inquiry the young engine builder replies as follows: "I have your letter asking for a description of how I built my steam engine. The castings are made of babbitt metal; such parts as the connecting rod, eccentric rod, and slide bars were sawed out of iron and brass. The cylinder is brass. The piston was made by casting solid and then turning a deep groove in it and then made steam tight by winding with packing. The valve seat and valve was made true and steam tight by grinding with emery and oil. I built the engine with tools that may be found about any house, and worked at it mostly at night. One engine the cylinder is 2 x 2 in.; the smaller one has a cylinder 1¼ x 1¾ in. Patience and keeping at it is more than anything else." HOWARD BURR.

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My offer is as broad as humanity itself. For sickness knows no distinction in its ravages. And the restless patient on a downy couch is no more welcome than the wasting sufferer who frets through the lagging hours in a dismal hovel.

I want EVERYone, EVERYwhere to test my remedy.

There is no mystery—no miracle. I can explain my treatment to you as easily as I can tell you why cold freezes water and why heat melts ice. Nor do I claim a discovery. For every detail of my treatment is based on truths so fundamental that none can deny them. And every ingredient of my medicine is as old as the hills it grows on. I simply applied the truths and combined the ingredients into a remedy that is practically certain. The paragraphs below will show you the reason why.

In eighty thousand communities—in more than a million homes—Dr. Shoop's Restorative is known. There are those all around you—your friends and neighbors, perhaps—whose suffering it has relieved. There is not a physician anywhere who dares tell you I am wrong in the new medical principles which I apply. And for six solid years my remedy has stood the severest test a medicine was ever put to—I have said "If it fails it is free"—and it has never failed where there was a possible chance for it to succeed.

But this mountain of evidence is of no avail to those who shut their eyes and doze away in doubt. For doubt is harder to overcome than disease. I cannot cure those who lack the faith to try.

So now I have made this offer. I disregard the evidence. I lay aside the fact that mine is the largest medical practice in the world, and come to you as a stranger. I ask you to believe not one word that I say till you have proven it for yourself. I offer to give you outright a full dollar's worth of Dr. Shoop's Restorative. No one else has ever tried so hard to remove every possible excuse for doubt. It is the utmost my unbounded confidence can suggest. Its open and frank and fair. It is the supreme test of my limitless belief.

Inside Nerves!

Only one out of every 98 has perfect health. Of the 97, sick ones, some are bed-ridden, some are half sick, and some are only dull and listless. But most of the sickness comes from a common cause. The nerves are weak. Not the nerves you ordinarily think about—not the nerves that govern your movements and your thoughts.

But the nerves that, unguided and unknown, night and day, keep your heart in motion—control your digestive apparatus—regulate your liver—operate your kidneys.

These are the nerves that wear out and break down.

It does no good to treat the ailing organ—the irregular heart—the disordered liver—the rebellious stomach—the deranged kidneys. They are not to blame. But go back to the nerves that control them. There you will find the seat of the trouble.

There is nothing new about this—nothing any physician would dispute. But it remained for Dr. Shoop to apply this knowledge—to put it to practical use. Dr. Shoop's Restorative is the result of a quarter century of endeavor along this very line. It does not dose the organ or deaden the pain—but it does go at once to the nerve—the inside nerve—the power nerve—and builds it up, and strengthens it and makes it well.

Many Ailments-One Cure

I have called these the inside nerves for simplicity's sake. Their usual name is the "sympathetic" nerves. Physicians call them by this name because each is in close sympathy with the others. The result is that when one branch is allowed to become impaired, the others weaken. That is why one kind of sickness leads into another. That is why cases become "complicated." For this delicate nerve is the most sensitive part of the human system.

Does this not explain to you some of the uncertainties of medicine—is not a good reason to your mind why other kinds of treatment may have failed?

Don't you see that THIS is NEW in medicine? That this is NOT the mere patchwork of a stimulant—the mere soothing of a narcotic? Don't you see that it goes right to the root of the trouble and eradicates the cause?

But I do not ask you to take a single statement of mine—I do not ask you to believe a word I say until you have tried my medicine in your own home at my expense absolutely. Could I offer you a full dollar's worth free if there were any misrepresentation? Could I let you go to your druggist—whom you know—and pick out any bottle he has on his shelves of my medicine were it not UNIFORMLY helpful? Could I AFFORD to do this if I were not reasonably SURE that my medicine will help you?

Simply Write Me

The first free bottle may be enough to effect a cure—but I do not promise that. Nor do I fear a loss of possible profit if it does. For such a test will surely convince the cured one beyond doubt, or disbelief, that every word I say is true.

The offer is open to everyone, everywhere. But you must write ME for the free dollar bottle order. All druggists do not grant the test. I will then direct you to one that does. He will pass it down to you from his stock as freely as though your dollar laid before him. Write for the order today. The offer may not remain open. I will send you the book you ask for beside. It is free. It will help you to understand your case. What more can I do to convince you of my interest—of my sincerity?

For a free order for a full dollar bottle address Dr. Shoop, Box 3353 Racine, Wis. State which book you want.

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HISTORY OF THE POM-POM—MADE PUBLIC FOR THE FIRST TIME.

By Its Inventor.

In the course of a recent discussion on machine guns at the Royal United Service Institution, Sir Hiram S. Maxim remarked that the history of the pom-pom had never been told. He proceeded to tell it as follows: "When I went into the machine-gun business, I was simply an engineer and electrician; but I had learned my trade fairly well. I made a gun and took it down to Hythe to fire in the presence of Lord Wolseley. The authorities there had never seen such a gun before. Usually guns used to jamb; they could not fire them at all. I remember twenty years ago that there was a lecture about machine guns, and so much said about their jambling and getting out of action that the general opinion seemed to be that they were useless. When Lord Wolseley saw this gun fired at a target 600 yards away, which was made of cast iron and when we ceased firing we heard forty shots strike the target after we stopped. It was very impressive. There were a lot of bullets in the air, and a lot of waves of sound coming back, and we heard those after the gun stopped firing. I had the honor of a seat at the right hand of his lordship, and we discussed machine guns. Some of the other officers joined us while they were smoking, and they asked me if I could make a machine gun which would have a range a great deal longer than the present one, that would penetrate a torpedo boat, that the ammunition should not be too dear, and which would be quite as effective as a small gun for meeting a crowd of savages as swords. After studying the subject a long time I began. We had a large powder chamber, ¾-inch bore, a projectile the shape of those used in military rifles, but the bullet had a steel core in it, and the bullet was made in segments, and the sectors of this were made by the envelope of lead and tin. It was strong enough to hold the bullet together in flight; but if you wanted it to scatter you could move a little lever, which brought three or four points of steel in front of the middle and scratched the envelope and gave a scattering result, like grape and canister at short range. That seemed to meet every requirement. The question came as to whether it would not be considered an explosive bullet, because it all went to pieces. So I changed it so that the projectile weighed over one pound, and that was the pom-pom; and that is how the pom-pom happened to be made. That particular form of gun was very much enlarged. The first one used ammunition the same as the Hotchkiss, and afterwards they were made considerably longer for the U. S. government, and still longer for the English. So the pom-pom at the present moment is rather a powerful arm, considerably heavier than at first. It at first fired 400 rounds a minute, but I have reduced the speed down to 300."

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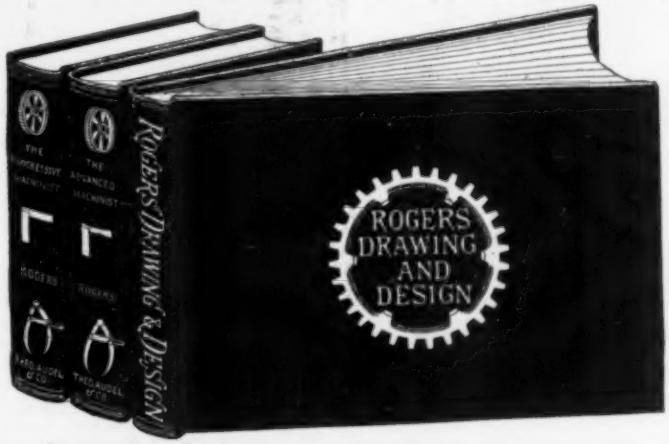

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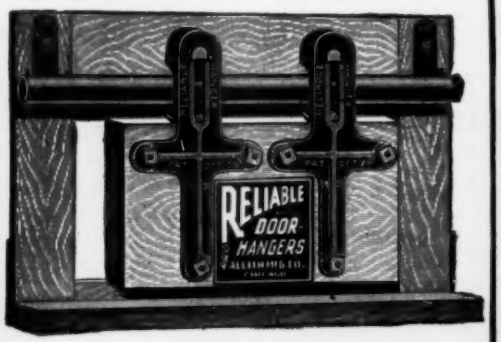

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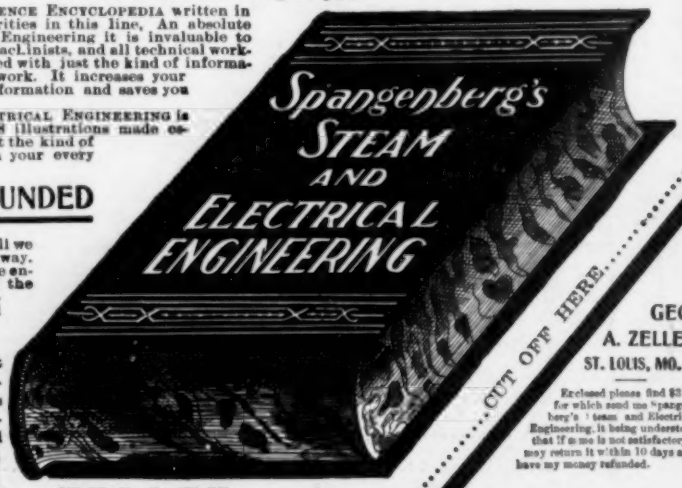

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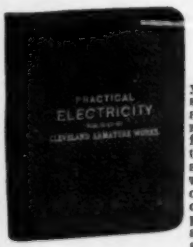

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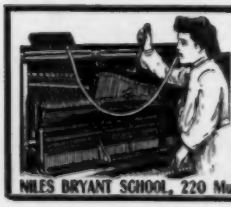

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TELEPHONE WILL NOT SUPPLANT TELEGRAPHY IN DISPATCHING TRAINS.

The report has been widely circulated by the newspapers that the Chicago, Burlington & Quincy railroad company has decided on making a sweeping change in their system of dispatching trains and will replace the telegraph with the telephone system just as rapidly as it can be brought about. This report is entirely in error. The company has made auxiliary use of the telephone for this purpose on a few unimportant branches, just as many other big railway systems in America have done, but further than this has made no change in this direction, nor contemplates any at present.

It is, indeed, much doubted that the telephone will ever supplant the use of telegraphy and the efficient Morse code. There has been a great deal said on the matter, but the practicability of such change still rests with the future to prove.

TICKING EGGS FOR SETTING HENS.

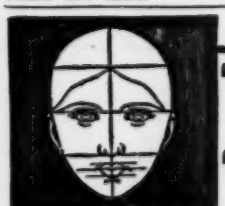
A Minnesota man who takes great pride in a small, well-stocked poultry farm has discovered a reliable method of preventing hens from setting at any and all seasons on anything that comes handy, from eggs to door knobs. He procured a cheap watch which has a loud, clear tick and had it enclosed in a white egg-shaped case. Whenever a hen begins setting out of season the poultry man places the ticking egg beneath her. The noisy egg worries the setting hen, and she stirs it around, thinking the chicken within wants to get out. With the continued ticking her nervousness increases; she is apt to leave the nest and move frantically about, but at last realizing that all her demonstrations are of no avail she abandons the nest.

The genius who devised this neat little scheme uses six of these eggs and claims that it pays in that the hens continue laying instead of setting.

A NEW FISHWAY.

A new fishway will be finished at Oregon City, Ore., next spring to enable salmon to reach the tributaries of the Willamette, where few of them have ever been able to get.

This fishway should have been built years ago, as the people of the Willamette valley need salmon and other sea fish that thus far have been unable to climb the falls.



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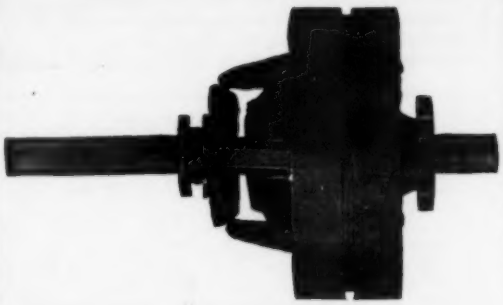

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AN INTOLERABLE SUSPICION.

The janitor of a small school tendered his resignation to the committee, and remarked, in the course of his letter, that the suspicion upon him was unbearable.

He was called before the board for an explanation.

"Well, gents," he said, "I am honest, and I won't stand being suspected. If I find anything about the school when I am sweeping, I always return it. Every now and again the teacher, or some one that is too cowardly to face me, gives me a slur.

"Why, a little while ago I read on the blackboard: 'Find the least common multiple.' Well, I looked all over the school for that; and I shouldn't know the thing if I met it in the street.

"Last night, in big writin' on the blackboard, it said: 'Find the greatest common divisor.' 'Well,' I says to myself, 'both of them things are lost now, and I'll be accused of stealing 'em, so I'll quit!' "

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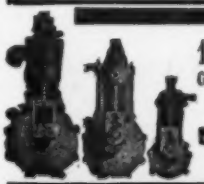

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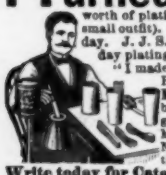

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When the machine finished its cylinder and stopped the Indian pointed at it, smiled an expansive smile, and remarked:

"Huh! Him canned white man."—Saturday Evening Post.

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It is said to be quite possible to preserve butter in such a manner that after a period of two years it will still be good and fine-tasting. Melt the butter in well-glazed earthen pans at a heat not exceeding 180 degrees Fahrenheit in a water bath, and keep it heated, skimming it from time to time, until the butter becomes quite transparent; then pour off the clear into another vessel and cool it as quickly as possible by surrounding it with cold water or ice.

Mix well together one ounce each of saltpeter and white sugar and two ounces of the best salt, all in very fine powder; then add one ounce of this mixture to every pound of butter and thoroughly incorporate them together. The butter thus prepared is then to be tightly pressed into clean glazed earthenware vessels, so as to have no vacant spaces. This butter does not taste well until it has stood for two or three weeks, after which it acquires a rich marrow flavor, which no other butter possesses. Any good, well-made fresh butter, free from butter-milk, will succeed by this method.

Dr. Evans, the American dentist, who achieved such success in Paris, once received, before he went abroad, a letter from a young Vermonter who wanted a set of false teeth made and sent to him. The letter concluded: "My mouth is three inches acrost, five-eighths inches threw the jaw. Some hummocky on the edge. Shaped like a hoss shew, toe forard. If you want me to be more particular I shall have to come thar."

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One day McGrane approached Rooney, and said: "Mike—I mean sergeant—s'pose a private stepped up to a sergeant and called him a conceited monkey, phwat wud happen?"

"He'd be put in the gyard-house."

"He wud?"

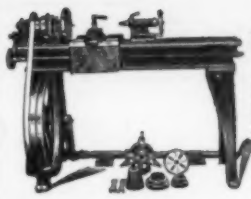
"He wud."

"Well, now s'pose the private only thought the sergeant was a conceited monkey and didn't say a wurd about it. Wud he be put in the gyard-house?"

"Av coorse not."

"Well, then, we'll let it go at that."

The whaling bark Josephine, of New Bedford, has obtained 1,200 barrels sperm oil and 300 barrels whale oil in less than a year's time. This is one of the richest cargoes reported in years.



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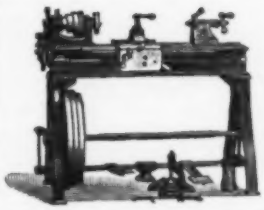

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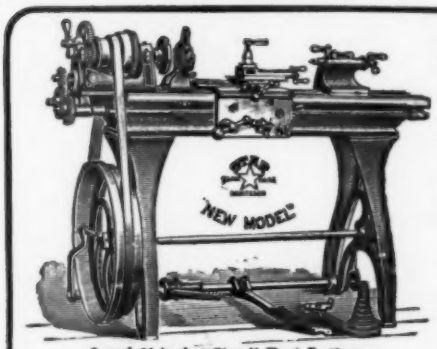

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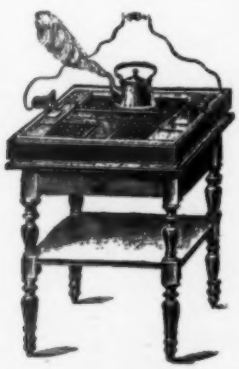

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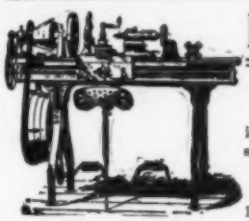

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New York, 1885
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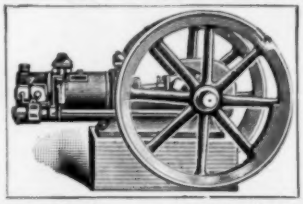

Chicago World's Fair, 1893
Atlanta, 1895
New York, 1896
Nashville, 1896
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TAXOMETERS COMPUTE CAB FARES.

In Paris and in several other large continental cities an instrument called a taxometer is used to determine the amount of cab fare a passenger must pay according to the distance traveled, or, if he wishes to go at a rate slower than five miles, and during stops the amount is reckoned by time occupied.

When one enters a cab the driver lowers to a horizontal position a small metallic flag bearing the word free and the taxometer, which in the beginning is set at 7.5 centimes (14.475 cents), immediately begins to work. The figures remain the same for the first 1,300 yards, after which 10 centimes (1.93 cents) are added for each additional 430 yards. A dial below set at 25 centimes (4.825 cents) computes the charge for packages. When the passenger pays, the driver again raises the flag to a vertical position and all figures are effaced. The rate by time is 10 centimes (1.93 cents) for three minutes. The driver sets the time mechanism, but as soon as the rate increases to more than five miles an hour the apparatus adjusts itself automatically and records by time.

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A captain on one of the ferry boats plying in New York harbor tells the following story of the value of a coat of paint:

"Some years ago I owned a small sailing vessel engaged in the coast and West Indian trade. While we were lying at an East River pier taking on a cargo for the West Indies, a stranger approached, and, after critically eyeing my craft, asked:

" 'What'll you take for that boat?'

" 'One thousand eight hundred will buy her,' I told him.

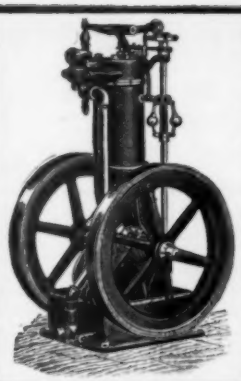
" 'I'll give you thirteen hundred,' replied the stranger. 'She's an old boat, and not worth any more.'

"I refused his offer, and he soon disappeared, but I made up my mind that I would spend a little money for white lead and oil, and when I was lying in port unloading the cargo I would have my men paint up the boat and improve her appearance. When I sailed into port again she looked as good as new. After reaching the pier I saw the same fellow walking about, looking the craft over. Soon he approached me and asked:

" 'Excuse me, sir, how much will you sell her for?'

" 'You can have her for $2,500,' I told him.

" 'Call it $2,300 and I'll take her,' he replied, and it didn't take me long to accept the offer. I calculated I made a thousand on $20 worth of paint."



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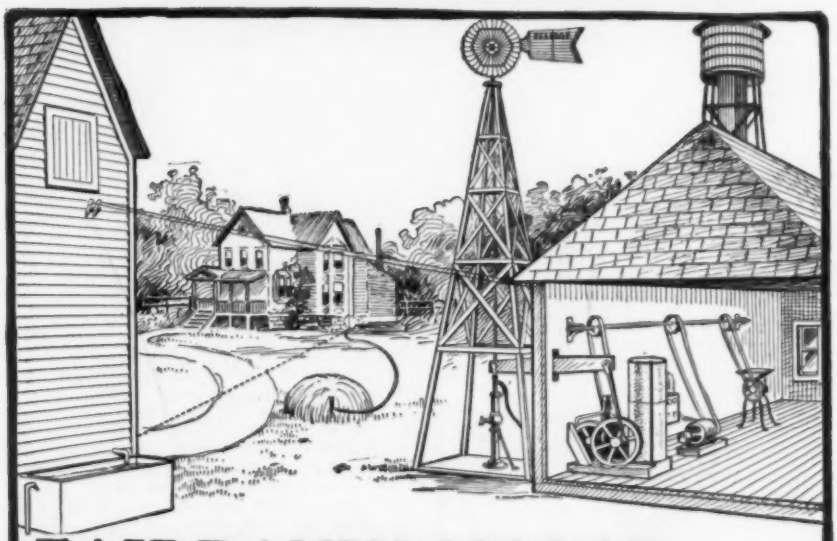

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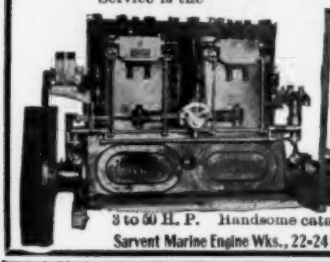

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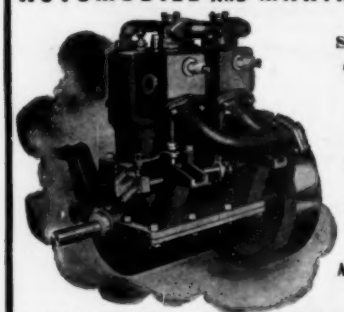

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RADIANT, A NEW FUEL.

A new fuel called Radiant, to be used in connection with gas and other fires, has been invented, says the Daily Mail of London, by two young engineers of Southend, England, and if it be proved that it can do all that is claimed for it, it will cause a great revolution in the present system of gas heating as did the introduction of the Welsbach mantle in gas lighting. The inventors claim for Radiant—1. That it gives treble the heat with the same gas consumption as an ordinary gas fire. 2. That it takes up the carbonic oxide from the air and purifies the atmosphere. 3. That it does away with the unpleasant smell given off by gas fires. 4. That it burns brightly like a coal fire. 5. That it is as cheap as fire clay and is inexhaustible.

The two young inventors are connected with one of the largest firms of gas engineers in the country, and have been experimenting for years with a view to producing a fuel such as Radiant. Radiant will take the place of the asbestos or fire clay balls, and will, it is said, give out an intense heat. It is made from materials that are now waste products of chemical works. The new fuel captures the blue flame, which at present is lost, and converts it into intense heat. Radiant is also said to possess the power of retaining heat to a very great extent.

AUTOMOBILE TORPEDOES FOR HARBOR DEFENSE.

"In many harbors, owing to a great depth of water, rapid current and kindred causes, it is almost impossible to establish a reliable system of mines, and in this field the automobile torpedo is almost without a rival," declares Lieut. Lloyd H. Chandler, U. S. N. Its great advantage is in the ease with which it can be fired. The recoil of firing is not great and the regular firing tube can be set up anywhere in a short space of time. No launching apparatus is necessary; an old barrel with the heads knocked out will serve as an apparatus for pointing the torpedo, and while two men stand in the water and point it, another pulls the starting lever, and good firing results.

For submerged firing from a stationary battery on shore a coffer-dam can be extemporized from any available material by an average carpenter's gang, and an above-water tube from which the spoon has been removed, secured in a hole in the coffer-dam by a form of sluice valve. This style of harbor defense, says Lieut. Chandler, offers powerful advantages.

From permanent shore batteries, by using a torpedo double the size of those used aboard ship, a range of 5,000 yards at 30 knots could be attained by a torpedo carrying 200 pounds of explosive, and for the first 1,000 yards the speed would be over 40 knots. Range and the position of the enemy can be readily determined from a shore battery so that such a weapon would be absolutely accurate.

Mr. Chandler believes that the use of the automobile is an absolute necessity in many harbors and would render forcing a harbor or maintaining a successful blockade impossible except at a cost too great for any nation to contemplate.

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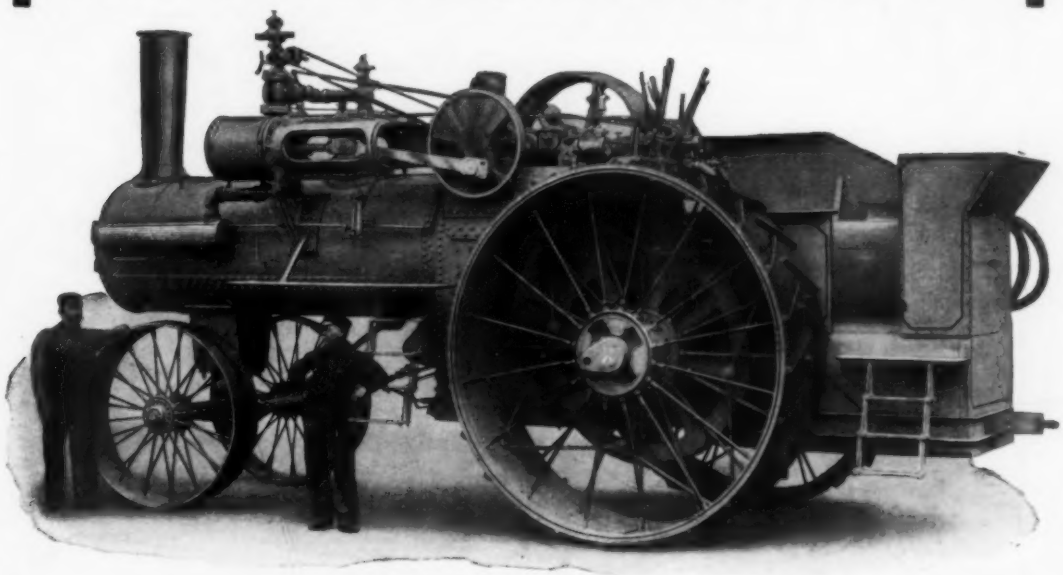

The picture on the front cover as well as the descriptive article on page 1210 refers to the Monster Road Locomotive manufactured by the

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69.50 "Little Giant" One-Horse Gasoline Engine
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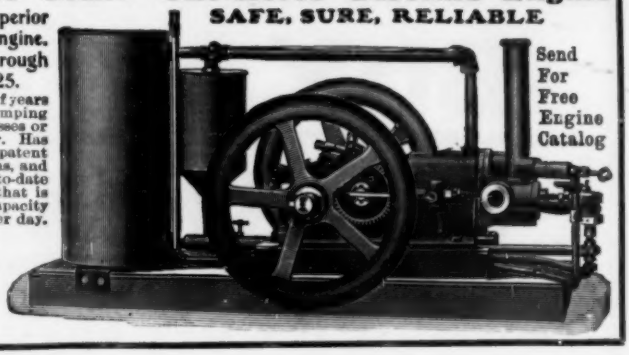

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This engine has been on the market for a number of years with good success. It is especially desirable for pumping water, for operating cream separator, printing presses or other machinery requiring not over one horse-power. Has two fly wheels, 15 in. in diameter, that weigh 80 lb., patent catch governor, permitting no useless compressions, and all necessary accessories, of the most modern, up-to-date patterns, ready for immediate operation. All that is necessary is to fill tank and start. Its pumping capacity has been known to be several thousand gallons per day. It is constructed of first-class material and is carefully tested before being sent out. Can be operated at an expense of about one cent per hour. Weight about 225 lb. Floor space necessary is 3 ft. 10 in. x 22 in. **Send for Free Engine Catalog**. We have other engines that will interest you.

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THE NATIONAL FLAG.

The official flag of the United States bears forty-five stars in a blue field, arranged in six rows—the first, third and fifth rows having eight stars each, and the others having seven stars each. The garrison of the army is made of bunting, thirty-six feet fly and twenty feet hoist; thirteen stripes, and in the upper quarter, next the staff, is the field or "union" of stars, equal to the number of states, on blue field, over one-third length of the flag, extending to the lower edge of the fourth red stripe from the top. The storm flag is twenty feet by ten feet and the recruiting flag is nine feet nine inches by four feet four inches. The "American Jack" is the "union" or blue field of the flag. The revenue marine service flag, authorized by act of Congress, March 2, 1799, was originally prescribed to "consist of sixteen perpendicular stripes, alternate red and white, the union of the ensign bearing the arms of the United States in dark blue on a white field." The sixteen stripes represented the number of states which had been admitted to the union at that time, and no change has been made since. Prior to 1871 it bore an eagle in the union of the pennant, which was then substituted by thirteen blue stars in a white field, but the eagle and stars are still retained in the flag. June 14, the anniversary of the adoption of the national flag, is celebrated as flag day in the public schools, and by the display of the emblem on public buildings and private houses in a large part of the union.

THE NATIONAL FLAG.

Our readers can help Popular Mechanics very greatly if they will kindly call the attention of some friend to the magazine. If you like it, there are others who would, if only they knew about it. Please tell some one friend about "Pop."

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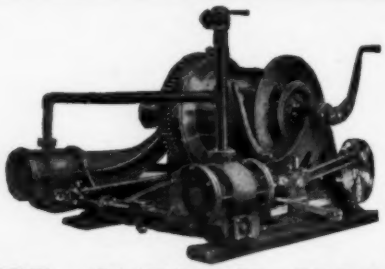

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SELF-PROPELLING FIRE ENGINES PRAISED BY A BOSTON FIRE CHIEF.

At the convention of the International Association of Fire Engineers held at Chattanooga, Tenn., in September, Chief W. T. Cheswell, of Boston, Mass., read a paper on self-propelling engines in which he stated that two of these engines were installed in the very heart of the hazardous fire section, with a fairly busy running card and that from the date of going into service they had averaged 50 runs a year.

"These engines," Chief Cheswell adds, "are what is termed a double extra first size engine, both of like construction and dimensions, weighing 17,000 pounds. Diameter of cylinder, 9½-inch; diameter of pump, 5¾-inch; length of stroke, 8-inch; capacity, 1,200 to 1,300 gallons a minute. When at their stations there is 90 pounds of steam pressure registered on the gauge at all times, this steam being supplied from a heater in the basement of the station, and connected by steam pipe to engine. This heater will consume about three tons of coal a month.

Upon receipt of an alarm to which the engine responds it is immediately started, the fire under the boiler not being lighted until crossing the threshold, the boiler gradually gaining steam until, on arrival at the fire after the shortest run, the gauge will register 125 pounds.

"After the engine is placed in the position required a key that connects driving gear to main shaft is removed, and we then have the ordinary steam fire engine ready for work.

"These engines are equipped with a fresh water tank holding 100 gallons that in case of necessity can be refilled from any hydrant, a short piece of 2½-inch hose being carried for this purpose; but as they run three miles without refilling the tank, in my recollection it has never been necessary to stop for water.

"Our self-propelling engines have given excellent service, and not one instance is recorded where they failed to report at the scene of the fire in good season; and there is an instance in my recollection in responding to an alarm during a heavy snowstorm, an engine drawn by five horses was stalled, and one of these propellers cut through the same snow drift without much ado. In ordinary going they can be driven as fast as required.

"They can climb quite a grade; in fact one of them is on the running card to a box at the top of a long hill in preference to an engine drawn by horses located at the same station. They can be housed after returning from response to an alarm very quickly, and without much work. Their repairs have not been noticeably in excess of our horse engines.

"The spur tires are renewed but once a year on the forward wheels and three times on the rear wheels."

The chief expressed the opinion, however, that no matter how good this apparatus, even with its great water capacity, results will not be satisfactory unless it is intelligently operated, and that the success depends entirely on the rank and file of the department, who must drill constantly.

TALC PRODUCTION OF 1903.

The talc or soapstone production of the United States during 1903 was 86,901 short tons, a decrease of 11,053 tons as compared with 1902. The value of the 1903 output is placed at $840,000. The production is classified as rough, sawed into slabs, manufactured articles, and ground talc. Fibrous talc is in great demand among paper manufacturers as a filler for paper and from the fact that its fibrous character gives additional strength to the paper.

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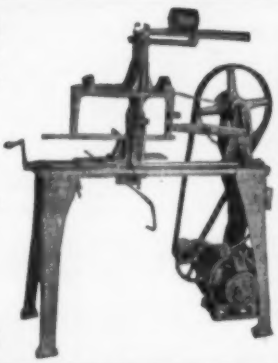
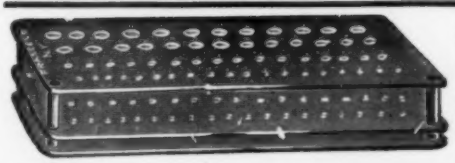

A Roth Motor Drives this Hacksaw.

Frasse Combined Drill Gauge and Block



This Gauge gives all sizes of Drills, Nos. 1 to 60. The holes are numbered showing just the drill looked for. The two lower plates serve as a support to keep the drills uniform. Everyone should have one of these. This will be mailed for 75c., postage 8c.

FRASSE ROLLER BOILER TUBE EXPANDER

This Expander suits any automobile boiler tube measuring 1-2 in. inside. Made of Stubs' Steel, carefully ground to exact size. The rollers cannot drop out.

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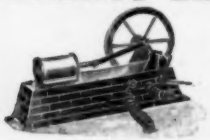

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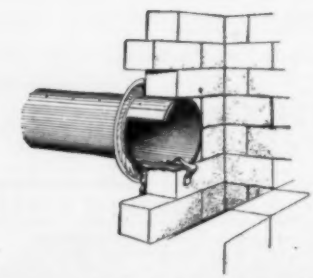

chimney end, as shown in Fig. 1, the shape of the inner end providing some compensation for varying thicknesses of room plaster. Before the pipe is inserted in the hole, as shown in Fig. 2, this holder is sprung into place at the bottom of the opening, and the pipe is pushed into the tongue at its inner end. No tools are needed in attaching it to the pipe.

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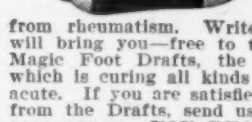

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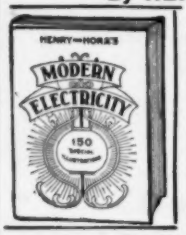

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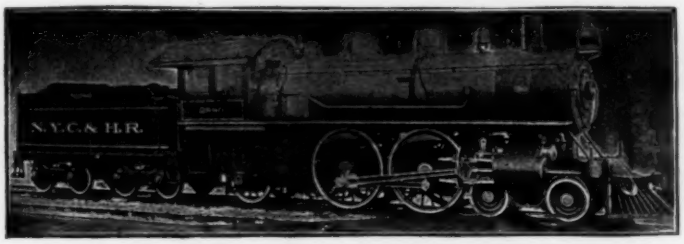

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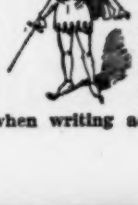

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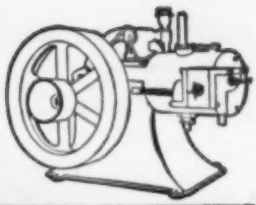

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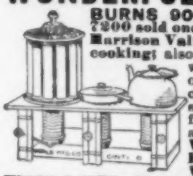

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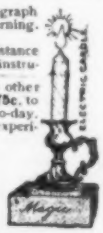

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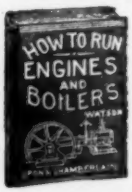

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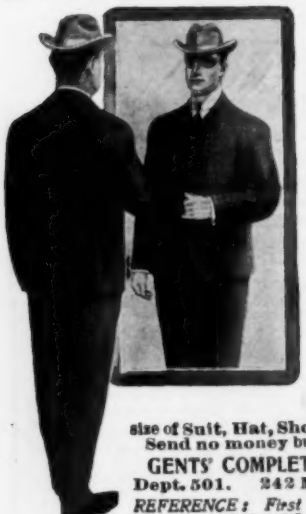

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Twelve days were spent by experts lately in trying to open the steel door of a vault of a Dayton, Ohio, trust company. The door was at last opened with a crowbar. A small steel hook slipped in through one of the holes bored in the steel, had hauled back the lock frame unknown to the expert who was at work. The crowbar was tried as a last resort before burning the door to pieces by electricity.

Inside it was found that a thin stream of glycerin had leaked from the glycerin cup, trickled down the lock frame and hardened, practically glueing the door shut by not permitting the frame to slide back far enough to release the bolts. The glycerin is in a cup at the center of the door. In this cup works a piston which breaks the jar of the springs when they are released by the time lock and unlock the door. The glycerin, the expert thinks, had probably been leaking drop by drop for many weeks.

The job of opening the door was the biggest that experts had found in years and many of them said it broke all records. Skilled men appeared from all over the country to proffer advice during the twelve days of hard work. One day a man came in and quietly announced that he could get into the safe in a short time, that, in fact, he made his living by getting into safes. The "expert's" picture was thought to be in the rogues' gallery at the central police station, so his services were not accepted.

It took four days of constant drilling to put the first hole through the door of the safe. Then, after knocking away all lose mechanism inside, a second one was drilled through by electricity in eighteen hours. Through this the time lock was knocked down and many other things put out of business. But still the door held. Then the bank officials suggested drilling through three feet of the side wall, which is made of concrete and crisscrossed bars of steel. The expert objected. Then they suggested his going through the five-foot wall in the rear and again he objected.

Finally all hope of opening the door without ruining it or the entire vault was given up and expert electricians were summoned to attack it. But one expert didn't like to give up and kept on tinkering at it. With a long steel hook he reached inside the door through the last hole bored and caught hold of the glycerin box and pulled. Nothing seemed to move and the hook was thrown on the floor in disgust.

Just to prove to himself that the door would not open, he had the safe company's expert pry on the hinges with a crowbar. Without the least bit of trouble the door slowly swung out. Five minutes later the electricians walked in with supplies of carbon, coils and tools, but they were sent home. They had predicted that they could open the door in four hours by burning a hole in it large enough for a man to insert his hand and manipulate the locks. But the hole would have spoiled the door. As it was, the two small holes, about an inch in diameter, could be plugged up and the broken mechanism repaired, making the door stronger than ever.

Immediately after opening the main door bookkeepers were called in and set to work fixing up the books for the twelve days they have reposed quietly in the safe. The watchman was also given an extra word of caution. But to the layman the safe still seemed absolutely impregnable, for, after getting through a second door almost as large as the first and a steel gate, you are only in the vestibule of the vault. To reach the inner precincts another steel gate has to be opened to get to a last safe, which also has two doors.

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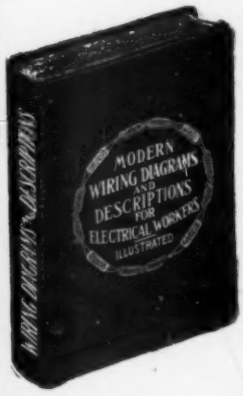

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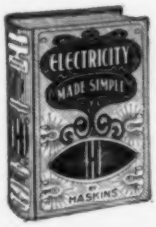

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THE FIRST STEP

If you have made an invention and contemplate applying for a patent, the first point is to learn whether your idea is new and patentable. Do not depend on the fact that you or your friends have never seen anything of the kind. Send us a pencil drawing, showing plainly your invention, and write out a description of its construction and operation, as well as you can. If you have a model, send it instead of the drawing. We will compare your sketch or model with all patents issued in the United States for inventions resembling yours, and for inventions in which similar mechanical constructions or principles are used. If a patent is found for an invention exactly like or closely resembling your idea, we will send you a copy of such a patent. If nothing is discovered to prevent getting a patent for your invention we will so advise you.

The charge for this service, unless otherwise agreed upon by special arrangement, is five dollars. This examination is an important step in connection with every patent application and requires great care and skill. An incompetent attorney may overlook a patent which closely resembles or completely anticipates your invention, or he may not know where to look. A dishonest attorney will purposely fail to find an anticipating patent in order that he may get the fee for preparing the application. The inventor is the loser in either case.

WHAT A PATENT COSTS

Opinion as to novelty and patentability of an invention, *after thorough examination* of United States patents	$ 5.00
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Preparing Oath, Petition, Specification and Claims	15.00
First Government Fee	15.00
Prosecuting application for patent	10.00
Total cost of application, first Government fee, official drawing, preparing all papers and prosecuting application in Patent Office	45.00
Within six months after the application has been allowed, the Government charges a final fee of	20.00
Thus the total cost of a patent for a simple invention is	65.00

Intricate inventions cost more to patent, but we will state the exact cost in advance in each case. We assist our clients in selling and promoting their patents without advance charges.

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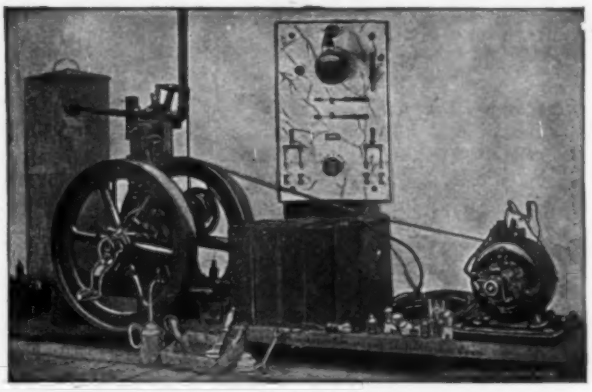

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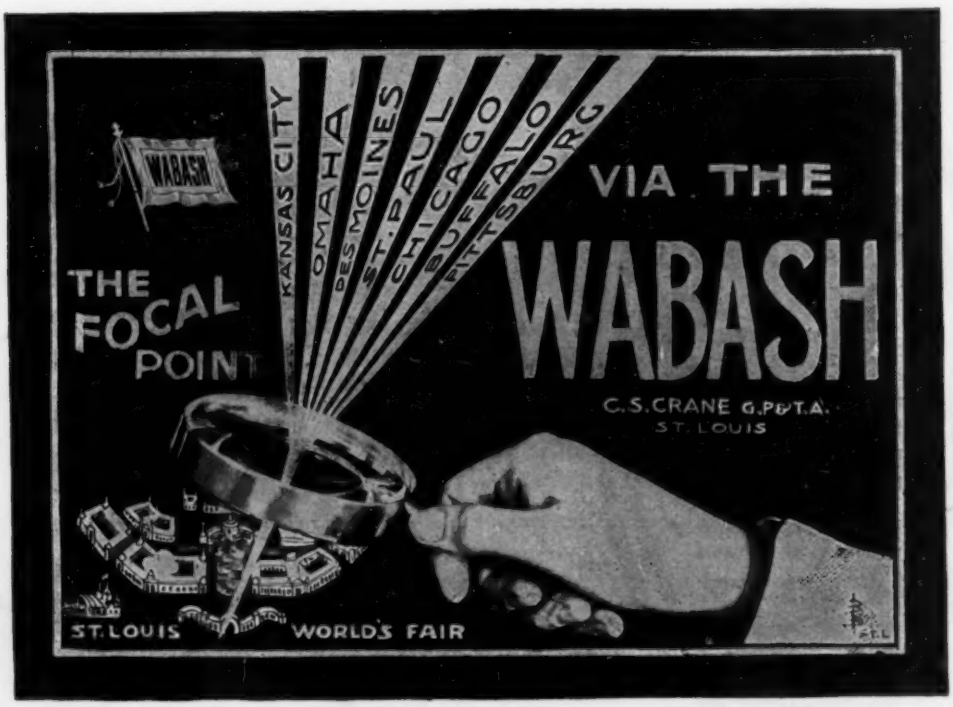

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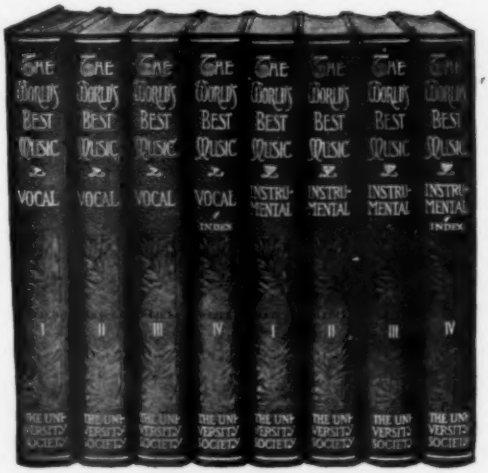

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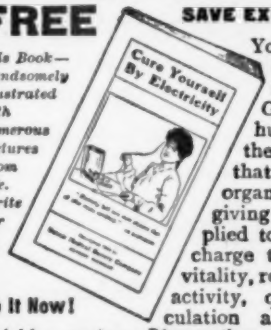

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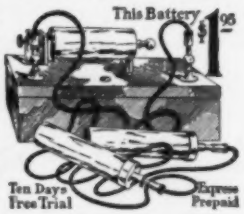

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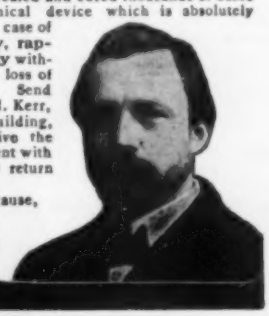

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